AD-A196 476

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(1)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFIT/CI/NR 88- 128	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AIR QUALITY MANAGEMENT ALTERNATIVES: USAF FIREFIGHTER TRAINING FACILITIES.		5. TYPE OF REPORT & PERIOD COVERED PHD ~~MS~~ THESIS
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) RICHARD EARL BREWER		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS AFIT STUDENT AT: UNIVERSITY OF NORTH CAROLINA - CHAPEL HILL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 1988
		13. NUMBER OF PAGES 296
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) AFIT/NR Wright-Patterson AFB OH 45433-6583		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

DISTRIBUTED UNLIMITED: APPROVED FOR PUBLIC RELEASE

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

SAME AS REPORT

18. SUPPLEMENTARY NOTES

Approved for Public Release: IAW AFR 190-1
LYNN E. WOLAVER Lynn Wolaver 21 Jul 88
Dean for Research and Professional Development
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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ABSTRACT

RICHARD EARL BREWER, Major, USAF BSC

Air Quality Management Alternatives: United States Air Force Firefighter Training Facilities. Under the direction of DR. DONALD L. FOX. 1987, 296 pages, PhD Environmental Engineering, University of North Carolina at Chapel Hill

Air pollutant emissions from firefighter training fires are a small portion of all annual air emissions from fixed and mobile sources at an Air Force installation. However, a single practice fire burning 300 gallons of aviation fuel releases an estimated one ton of criteria air pollutants during a one to five minute period. Bases report conducting firefighter training 4 to 134 times per year, burning 100 to 2000 gallons of fuel per fire. Based on current emissions inventory methodology, 4 installations emit over 100 tons of air pollutants annually from firefighter practice fires.

EPA has not promulgated process emission standards for firefighter training facilities. Current State regulations, standards and rules have varying requirements pertaining to conducting open burning for purposes of firefighter training. Many personnel with responsibilities in environmental management and protection programs are not knowledgable or aware of State required administrative and managerial procedures pertaining to permits, coordination, and notification. Current firefighter training supervisory recording and reporting procedures contributed to a lack of common knowledge and understanding relevent to the extent and magnitude of firefighter training.

A research methodology utilizing questionnaires, interviews, and site visits is developed and applied. This method enabled fire prevention, and environmental management experts and professionals to provide data, opinions, and to evaluate candidate air quality management alternatives. Analysis of survey data, interview findings, opinions, and management alternative evaluations integrated with air quality management indexes developed through this research lead to the study conclusions and recommendations.

Full implementation of the guidelines would result in an estimated reduction in training fire air emissions of nearly 70 percent annually. A single practice fire should train or evaluate 20 firefighters, and burn no more than 300 gallons. The number of firefighters in a department should determine the required number of annual practice fires.

Implications for future policy and actions include recommendations to improve recording and reporting data via Facility Use and Firefighter Training Indexes. If adopted, the policy and actions would result in a more efficient and standardized firefighter training program Air Force-wide. Further research is needed to verify air emission factors, and to determine concentrations of PAH emissions in smoke and fugitive soot particles.

AIR QUALITY MANAGEMENT ALTERNATIVES: UNITED STATES AIR FORCE FIREFIGHTER TRAINING FACILITIES

by

Richard Earl Brewer

A Dissertation submitted to the faculty of The University of North Carolina at Chapel Hill in partial fulfillment of the requirements of the degree of Doctor of Philosophy in the Department of Environmental Sciences and Engineering.

Chapel Hill

1987

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ACKNOWLEDGEMENTS

Many organizations and individuals provided support and assistance throughout this project. I want to gratefully acknowledge the following contributors, who without their support and advice this research could not have been completed:

Members of my Doctoral Committee for their friendship, guidance, and review of the Dissertation;

Air Force Institute of Technology, Wright-Patterson AFB, Ohio, for again supporting me as a student;

Air Force Engineering and Services Center, Tyndall AFB, Florida, for the research grant that provided funding for travel, supplies, and communication expenses associated with this project;

Mr. Howard M. Segal, FAA Office of Environment and Energy, Washington D.C., for his generous contribution of software that enabled me to calculate emission and dispersion estimates;

Defense Technical Information Center, Cameron Station, Alexandria, Virginia, for their always timely support of my endless requests for documents;

The many Fire Chiefs, Environmental Protection Officers, and Bioenvironmental Engineers who took time to support this work by completing questionnaires, providing reports/information, participating in interviews, and providing on-site visit assistance.

My special thanks to Dr. Donald L. Fox, my Dissertation Advisor. I could not have succeeded were it not for his unselfish dedication, encouragement, and guidance throughout my Doctoral program.

Karen, my partner, contributed more to the success of this project than she will ever know. Her efforts in preparing the manuscript, keeping me on schedule, and supplying encouragement when I needed it most, madc this possible.

I would like to dedicate this work and Dissertation in loving memory to Mrs. Anita Brewer, who shared her life with us. We will miss her very much.

ABBREVIATIONS AND ACRONYNS

AFB	Air Force Base
AEI	Air Emissions Inventory
AFESC	Air Force Engineering and Services Center, Tyndall AFB, Florida
AFIT	Air Force Institute of Technology, Wright-Patterson AFB, Ohio
AFMxx-x	Air Force Manual
AFPxx-x	Air Force Pamphlet
AFRxx-x	Air Force Regulation
AFWL	Air Force Weapons Laboratory, Kirtland AFB, New Mexico
BAP	benzo(A)pyrene
BEE	Bioenvironmental Engineer
BNDRY	Installation Boundary or Property Line
CAA	Clean Air Act
CARB	California Air Resources Board
Category A	Bases with Bomber/Tanker/Transport Mockups
B	Bases with Fighter or Trainer Mockups
C	Bases with Rotary Wing, None, or Unknown Mockup Type
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNSTDT	Firefighter Training Facility Construction or First-use Date
Class 1	Bases with Bomber Mockup
2	Bases with Tanker Mockup
3	Bases with Transport Mockup
4	Bases with Fighter Mockup
5	Bases with Trainer Mockup
6	Bases with Rotary Wing Mockup
7	Bases with No Mockup
8	Bases Not Responding to Phase I Survey
DEEV	Typical Office Symbol for Environmental Protection Officer
DEMF	Typical Office Symbol for Fire Department
DERP	Defense Environmental Restoration Program
DOD	United States Department of Defense
DTIC	Defense Technical Information Center, Cameron Station, Alexandria, Virginia
EIA/S	Environmental Impact Assessment or Statement
EPA	United States Environmental Protection Agency
EPO	Environmental Protection Officer
FD	Fire Department
FEMA	United States Federal Emergency Management Agency
FFTF	Firefighter Training Facility
FONSI	Finding of No Significant Impact
FTI(1)	Firefighter Training Index, Firefighters Trained/Year
FTI(2)	Firefighter Training Index, Gallons of Fuel Burned to Train One Firefighter

ABBREVIATIONS AND ACRONYMS (Continued)

FUI	Facility Use Index, Tons Air Pollutants/Year
F/Y	Training Fires per Year
G/F	Gallons of Fuel Burned per Training Fire
IRP	Department of Defense Installation Restoration Program
JP-4	Jet Petroleum Fuel #4
MAJCOM	Major Air Command
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NTIS	National Technical Information System
OEHL	United States Air Force Occupational and Environmental Health Laboratory, Brooks AFB, Texas
OFBFAC	Distance to Nearest Off-base Facility
ONBFAC	Distance to Nearest On-base Facility
PAH	Polycyclic Aromatic Hydrocarbons
PITDIA	Diameter of Burn Surface, Feet
PRA	Polluation Regulatory Agency
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SGPB	Typical Office Symbol for Bioenvironmental Engineer
SIP	State Implementation Plan of the CAA
T.O.	Technical Order or Manual
TOS	Time on Station, Years
TOSCA	Toxic Substances Control Act
USAF	United States Air Force

CHAPTER I

INTRODUCTION

The introduction to this dissertation presents the background, purpose, hypothesis, and specific tasks of this research. United States Air Force (USAF) firefighter live-fire training background, benefits, and potential adverse air quality impacts are discussed. Six research task areas leading to the output of management guidelines are presented. A discussion of the literature review is also included in this section.

A. Background

1. United States Air Force (USAF) Firefighter Live-Fire Training

Subjecting aviation firefighters and emergency crash/rescue personnel to a burning fuel fire during initial career and periodic refresher training builds individual confidence, promotes professional teamwork, and provides a realistic firefighting experience (Dallman and DeLeo, 1976, p. 5). Firefighter training facilities (FFTFs) range from simple unlined earthen depressions to elaborately engineered facilities designed and equipped to minimize the potential for air, water, and land pollution. Fuels burned to create the live-fire training environment vary from common flammable building materials to petroleum based fuels. Prior to 1965-1970, firefighter training exercises were frequently conducted by burning waste aircraft fuel mixed with a wide variety of discarded industrial solvents, thinners, and other flammable wastes. Firefighter training facilities are generally equipped with mockups of

multi-story buildings, aircraft, automobiles, or other training aids depending upon the specific fire protection mission at a particular base. Different types of mockups serve as training platforms for instructing and evaluating markedly different firefighting/crash-rescue procedures. Structural fire suppression methods and extinguishing techniques are quite different from aviation or vehicular fire/crash-rescue response suppression and rescue procedures where petroleum based fuels are involved.

The Air Force conducts aviation firefighter/crash-rescue training by burning Jet Petroleum Fuel #4 (JP-4) at nearly every base that supports a flying mission having an active flightline. Each firefighter is required by Air Force regulations to receive live-fire proficiency training at least quarterly or more often if the individual is inexperienced or in apprentice training status (AFR 92-1 (C1), p. 21). Fuel to be burned is pumped into the burn basin either manually from a refueling truck or through a piped underground distribution system having above ground nozzles. The fuel is then ignited by hand using a pole and burning rag, or by remotely controlled electrical igniters. Once the fire is well established, protected firefighters and crash/rescue teams use fire suppression foam to "cut" a path through the fire. Upon reaching the mockup, one or more prepositioned manikins are retrieved, and the firefighters retreat along the original entry pathway (Haney, 1976, p. 7). The training fire is then extinguished. With experienced teams, this training exercise sequence should take less than three minutes from ignition to complete extinguishment. During these exercises, immense towering columns of dense black smoke can be released

from the training area. This smoke is a mixture of carbon monoxide, nitrogen oxides, sulfur oxides, suspended particulate matter, and volatile organic hydrocarbons.

In addition to the local periodic refresher training provided at individual bases, the Air Force operates a large Fire Protection Technical Training Center for instruction of entry level trainees. This center is designated for use by all services in the Department of Defense (Gott, 1978, pp. 12-15). The Center's Firefighter/Crash-Rescue Training Facility was designed to support year-round training for 10 days per month, 15 fires per training day, while burning an estimated 4,500 gallons of jet fuel per training day. At this rate, 540,000 gallons or 1,728 tons of fuel would be burned annually releasing over 800 tons of air pollutants according to the Center's Air Emissions Inventory for 1985.

2. Benefits

In addition, training fires have psychological benefits such as building firefighter confidence, teamwork, and department cohesion. They also test and demonstrate unit execution effectiveness and firefighting precision (Semple, 1973, p. 28) which can be related to potential lives saved and equipment or property losses averted.

Table 1.1 presents USAF aircraft fire incident information for 1982 and 1983. For example, in 1983, of the 105 aircraft fires recorded; trained firefighters extinguished 71, maintenance personnel put out 21, and the remaining 13 were self-extinguished or extinguished by automatic systems. Actual fire loss and damage were estimated at $38.2 million. Had the aircraft involved been total losses, over $1.2 billion in equipment would have been lost (USAF Maintenance Magazine, Jul/Sep 1983,

Table 1.1

Reported USAF Aircraft Fires - 1982 & 1983

Aircraft Fires	1982	1983
Fire Loss		
Number of Aircraft Fires	133	105
Put out by Firefighters	105	71
Put out by Maintenance Crews	23	21
Aircraft Value at Risk	$1.0 Billion	$31.2 Billion
Actual Aircraft Fire Loss	$44.7 Million	$38.2 Million
Combustible Material Initially Starting Fire		
Jet Fuel	76	52
Hydraulic Fluid	16	18
Electrical Component	12	4
Tires	12	13
Oil	5	2
Other Combustible Material	8	9
Unknown	4	9
Type of Aircraft Involved		
Bomber/Tanker/Transport	55	40
Fighter/Trainer	53	50
Other	25	15
Location of Involved Aircraft		
Runway	26	31
Taxiway	5	20
Maintenance Areas	69	37
Alert Area/Shelter	15	11
Other	18	6
Area of Aircraft Where Fire Started		
Engine	45	43
Wheel/Brake/Tire/Gear	25	34
External Fuel Tanks	24	4
Fueling Area	4	0
Cockpit/Crew Compartment	4	4
Other	31	20

pp. 22-23, and Oct/Dec 1984, pp. 16-17). However, since the 1983 aircraft fires were extinguished, an estimated 96.8% of the value at risk was saved. With increasing costs of new aircraft weapons systems, potential fire loss values are even greater.

3. Potential Adverse Air Quality Impact

The source of potentially toxic air pollutants from firefighter training facilities is the combustion or partial combustion of aircraft fuel or other fossil derived fuel. Emissions from open burning of fuel are different from normal jet aircraft exhaust emission profiles because: 1) combustion parameters are uncontrolled in open air burning because there is no combustion chamber, no regulation of the fuel to air ratio, and no afterburner; 2) fuel is pumped or sprayed on the ground or floated on top of a pool of water prior to ignition; 3) the fire is extinguished and sometimes re-lit before all fuel is consumed thereby altering the emission rate and organic species evolved due to varying combustion temperatures; and 4) operating procedures and post-exercise cleanup practices are not standardized and vary from facility to facility.

JP-4 fuel is used to power most USAF jet aircraft and is, therefore, the fuel of choice for creating live-fire training environments. It is a complex blend of up to 300 different hydrocarbons; composed primarily of aliphatic hydrocarbons (averaging approximately 10% aromatics) and 1% unsaturated hydrocarbons (Bishop et al., 1983 and Cooper et al., 1982, pp. 80-90). Each blend and lot can exhibit slightly different characteristics and be composed of varying concentrations of organic species depending on the geographic region of origin and distillation source. In addition, minor additives are

included in JP-4 to control oxidation, inhibit corrosion, prevent icing, and protect metal fuel system components.

Procedures used to conduct firefighter training influence the quantity of toxic air pollutants released by at least six mechanisms: 1) evaporation during application of fuel to the burn basin prior to ignition, 2) initial ignition period when the fire builds to a maximum burn rate, 3) uncontrolled emission of combustion by-products from facilities not provided with air pollution controls, 4) emission of partially or incompletely combusted hydrocarbons, 5) post-burn evaporation of residual fuel, and 6) deposition of air transported polycyclic aromatic hydrocarbon (PAH) ladened particulate matter.

Few indepth studies of air emissions or possible adverse environmental consequences of live-fire training at these facilities have been undertaken. In 1970, the USAF Occupational and Environmental Health Laboratory (OEHL) published a Technical Report on air emissions from a Navy fire training facility. The author stated, "The test of course is not complete for there may be literally thousands of organic materials present in microgram and nanogram quantities and we may never know if some of these may be significant, say as a carcinogen." (Suggs, 1971, p. 10). United States Navy research disclosed that 44.5 milligrams of PAH were present in each gram of soot sample taken from a fire fighting school. The author of that study warned: "These soots are shown to contain appreciable amounts of known carcinogens and consequently exposure to the smoke may well constitute a health hazard ...." (Long, 1972, p. 3). Research conducted in 1974 by the USAF Weapons Laboratory at Albuquerque, New Mexico, showed that at least

1,000 pounds of air pollutants were produced per 1,000 pounds of JP-4 jet fuel burned in the open without air pollution controls (Haney and Ristau, 1973, p. 16).

A full-sized prototype water-spray system was developed and evaluated by the USAF Civil Engineering Center. Air emission testing of this prototype firefighter training facility showed that the smoke-abatement system reduced particulates and carbon monoxide emissions by about 60% (Ibid.). The prototype was designed to decrease or eliminate the generation of particulate matter created by training fires, however, according to some experienced firefighters, the dense black smoke is an essential characteristic for a realistic training environment. Additionally, results of the Air Force Weapons Laboratory study indicated that the observed reduction in visible smoke was a result of the cooling of the flame by the water spray system which lowered the temperature of the fire, increasing the production of PAH. Inadequate combustion conditions, typical of uncontrolled open burning processes, consistently produce comparatively high emissions of PAH (Hangebrauck, von Lehmden and Meeker, 1967, p. 18).

Studies conducted by Radian Corporation, at an out-of-service military fire training facility, showed that volatile organic compounds continue to be released to the atmosphere from the soil following remedial cleanup. JP-5 (similar to JP-4) had been the fuel burned for firefighter training at this site. The same organic compounds were detected in the groundwater and headspace samples taken from monitoring wells penetrating this training site (Eklund, Balfour and Schmidt, 1984; Schmidt, Balfour and Cox, 1982).

Presently, many states exempt or waive regulation of air emissions from firefighter training facilities because they believe: 1) the benefit to society provided in terms of lives saved and property losses averted outweigh the adverse air pollution potential; 2) these facilities when viewed individually are generally not considered to be major stationary sources as defined by the Clean Air Act; 3) operators have voluntarily suspended burning industrial waste materials and solvents in training fires (AFR 92-1(C1), 1983, pp. 19-20); 4) emphasis for pollution controls for these facilities is now focused on surface and groundwater contamination potentials; 5) the cost of constructing new or modifying existing facilities with air pollution control systems, (Martin Marietta, "Cost Estimate," 1986, p. 57); and 6) inadequate training, resulting from fuel substitution or pollution abatement systems, is often believed to be unacceptable.

B. Research Hypothesis and Purpose

The hypothesis of this study is that air pollution emissions can be reduced at most USAF Firefighter Training Facilities through development, evaluation, and implementation of environmental air quality management alternatives, rather than constructing new, or renovating and equipping existing facilities with air pollution control systems.

The purpose of this research was: 1) to describe USAF Firefighter/Crash-Rescue Training Facility design, use and operation, 2) to formulate a methodology to evaluate environmental air quality management at live-fire training facilities, 3) to develop and evaluate management alternatives for reducing air emissions associated with open burning of jet fuel at these facilities, and 4) to propose a management

system based on study findings and conclusions, that could be applied to USAF Firefighter/Crash-Rescue Training Facilities.

C. Research Task Areas

This research focused on identifying management alternatives that emphasize changes in use and procedures rather than facility design or construction options to control air emissions.

1. Task #1: Describe and Quantify Current USAF Firefighter Training

A survey questionnaire was used to solicit information about firefighter/Crash-Rescue Training Facility design, location, use/procedure and fire department manning information from 97 Air Force bases in the Continental United States, Hawaii and Alaska. Responses were used to describe the facilities, quantify the magnitude of training, and estimate air pollutant emissions released during firefighter/crash-rescue training sessions.

2. Task #2: Compare Air Force Base Facilities

An identification system was used to make comparisons of training facility design, location, operation, and utilization within and between installation, mission, and geographic classifications. Each Air Force base was assigned a unique identification number which permitted respondents and bases to remain anonymous. USAF bases were divided into seven classes depending on the type of operational aircraft used and the type of firefighter training facility existing at each base. The seven classes were reduced to three broad categories based on the relative size of aircraft mockup used: bomber/tanker/transport, fighter/trainer, and miscellaneous. Geographical comparisons were based on the ten U.S.

Environmental Protection Agency Regions adapted for use. Indices of training facility use and training efficiency were developed to show relative tons of air pollutant released per year, and the number of firefighters trained per live-fire exercise at each base participating in this study.

3. Task #3: Estimate Dispersion and Potential Exposures

Air pollutant emission source strengths were calculated and compared using emission factors currently in use in Air Force air emission inventory guidelines and documents. A Gaussian Dispersion Model with Carson-Moses Plume Rise was used to estimate dispersion of particulates, carbon monoxide and hydrocarbons. A fire department survey, site visits, installation maps, and other reports found in the literature were used to identify areas and populations potentially exposed to released atmospheric pollutants.

4. Task #4: Investigate Regulatory Compliance

After identifying Federal, Air Force, and State air pollution, air quality management, and environmental protection standards and regulatory requirements, a survey questionnaire was sent to USAF Environmental Coordinators and Bioenvironmental Engineers. The results of this survey were used to measure management awareness and compliance.

5. Task #5: Evaluate Management Alternatives

Three groups of Air Force professionals, at base and regional headquarters management levels, were asked to participate in a survey of attitudes and opinions about firefighter training effectiveness, environmental pollution potential, and to evaluate air quality management alternatives. The management alternatives considered included operation and use of Firefighter/Crash-Rescue Training

Facilities, siting, and the use of smoke abatement systems. Participant responses were analyzed to identify key management factors and the positive and negative impacts associated with each of the selected air quality management alternatives.

6. Task #6: Prepare Management Guidelines

Advantages and disadvantages, facility and training costs, and other program impacts were considered in the development of management guidelines for emission reductions. These guidelines can be used by engineers and planners to evaluate, compare, and improve air quality managemen' at live-fire firefighter training facilities.

CHAPTER II

EXISTING POLICIES AND PROGRAMS

Chapter II contains a discussion of Federal, State, and local pollution regulatory acts, standards, regulations and rules pertaining to open-burning for purposes of training firefighters. An overview of USAF environmental protection and fire prevention programs, and activities highlighting responsible officials, Air Force regulations, and publications is included.

A. Applicable Federal Acts and Regulations

Four Federal environmental statutes have regulatory implications for the operation of firefighter training facilities: National Environmental Policy Act (1969), Clean Air Act (1970), Resource Conservation and Recovery Act (1976), and Superfund Amendments and Reauthorization Act (1986).

1. The National Environmental Policy Act (NEPA) of 1969 (Public Law 90-190, Amended by P.L. 94-52, and P.L. 94-83 of 1975) requires Federal agencies to analyze the potential environmental impact of proposed actions and alternatives and then use those alternatives in making decisions or recommendations on whether they should proceed with those actions. For major Federal actions NEPA requires the proponent to prepare a detailed statement on: 1) the environmental impact, 2) adverse environmental consequences that cannot be avoided, 3) alternatives, 4) relationships between short-term uses of the

environment and maintenance and enhancement of long-term productivity, and 5) any irreversible or irretrievable resource commitments. Environmental quality monitoring and reporting requirements were developed in response to NEPA and the President's Council on Environmental Quality. For firefighter training facilities, Environmental Impact Assessments are req red if new facilities are planned, or if a significant change in operation/utilization is proposed.

2. Clean Air Act (CAA) of 1970 (Public Law 91-604), in part, directs EPA to: 1) establish ambient air quality standards, 2) give states a timetable for developing State Implementation Plans (SIPs), 3) establish emission standards for hazardous air pollutants, and 4) set performance standards for new stationary sources.

a. National Ambient Air Quality Standards (NAAQS) have been promulgated by EPA for major air pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter, photochemical oxidants (ozone), and lead. The NAAQS include "primary" and "secondary" standards. Primary standards incorporate a margin of safety and are designed to insure immediate protection of the public from adverse health effects of air pollutants. Secondary standards were established to protect the public welfare from known or anticipated adverse effects of air pollutants (Table 2.1). The promulgation of NAAQS shall not be considered in any manner to allow significant deterioration of existing air quality in any area already in compliance.

The applicability of NAAQSs to firefighter training facility operation depends on the type and quantity of emissions from the

Table 2.1

National Ambient Air Quality Standards
(40 CFR Part 50, July 1986)

Pollutant	Primary NAAQS	Secondary NAAQS	Averaging Time
Sulfur oxide (as SO_2)	80ug/m^3 (0.03 ppm)		annual arithmetic mean
	365ug/m^3 (0.14 ppm)		24 hr
		1300ug/m^3 (0.5 ppm)	3 hr
Fine Particulate Matter	75ug/m^3	60ug/m^3	annual geometric mean
	260ug/m^3	150ug/m^3	
Carbon Monoxide	10mg/m^3 (9 ppm)	same	8 hr
	40mg/m^3 (35 ppm)	same	1 hr
Ozone	235ug/m^3 (0.12 ppm)	same	1 hr
Nitrogen Dioxide	100ug/m^3 (0.05 ppm)	same	annual arithmetic mean

facility and the pre-existing ambient air quality at the site. If the facility was or were to be located in a non-attainment ambient air quality area, the regulatory agency (EPA and/or State) would determine air pollution control requirements and this could possibly result in operational restrictions. In addition, depending on the classification

of land use where the facility is located, the incremental increase over the historical background level of ambient air quality could be specified to insure compliance with Prevention of Significant Deterioration (PSD) requirements. PSD Classes I, II, or III are applicable to NAAQS attainment areas only, and in no case can the air quality of a PSD area be allowed to exceed a NAAQS.

b. EPA has established national emission standards for particulates, nitrous oxides, sulfur oxides, carbon monoxide, and volatile organic compounds from certain industrial categories of mobile and stationary sources. Emission standards are designed to limit and minimize the release to the atmosphere of specific pollutants from all known major and fugitive emission sources. The types of industrial sources regulated to date include: power plants, cement and concrete plants, solid waste and sewage treatment plant sludge incinerators, acid plants, petroleum refineries and storage vessels, and lead smelters, and steel/brass/bronze ingot plants. Firefighter training facilities are not included under any of these sources for which specific emission standards have been set. Therefore, firefighter training facilities must, at most, meet only general emission control limitations placed on visible emissions (opacity standards) established in most SIPs (Booz, July 1981).

c. Section 112, of the CAA, has perhaps the greatest potential impact on the design and operation of firefighter training facilities. Section 112 provides for the establishment of National Emission Standards for Hazardous Air Pollutants (NESHAPs) in cases where there are no applicable NAAQSs. NESHAPs also include an ample margin of safety to protect the public health. Eight substances have

been listed as hazardous air pollutants: beryllium, mercury, asbestos, vinyl chloride, benzene, radionuclides, inorganic arsenic, and coke oven emissions. EPA has listed other compounds for possible regulation in the future (Table 2.2), (40 CFR Ch.1, Part 61, July 1986). Some of the candidate substances are emitted from firefighter training facilities as volatile organic emissions or in fugitive soot particles before, during, and after training exercises.

Table 2.2

Substances Under EPA Review for Regulatory Action As Hazardous Air Pollutants

acrylonitrile	ethylene oxide
1,3-Butadiene	hexachlorocyclopentadiene
cadmium	manganese
carbon tetrachloride	methyl chloroform
chlorinated benzenes	methylene chloride
chlorofluorocarbon	perchloroethylene
chloroform	Polycyclic Organic Matter
chloroprene	tolueneroethylene
chromium	trichloroethylene
epichlorhydrin	vinylidene chloride
ethylene dichloride	

3. The Resource Conservation and Recovery Act (RCRA), Subtitle C, of 1976, provides a framework for cradle-to-grave management of hazardous wastes. RCRA applies only to currently active or operating hazardous waste treatment, storage and disposal facilities. Hazardous wastes are defined by specific characteristics of ignitability, corrosivity, reactivity, and EPA extraction procedure (EP) toxicity. Waste substances that exhibit properties that pose a threat to human health (carcinogenicity, mutagenicity, teratogenicity, or

infectiousness) or the environment were not dealt with in defining hazardous waste under RCRA.

Firefighter training facilities, burning off-specification or waste JP-4 as currently defined by Air Force regulations and technical orders (containing less than 10% contamination by water or oil), may have to comply with RCRA requirements if used oil and fuel becomes classified by EPA as a federally listed hazardous waste. This could mean that to burn waste JP-4 for live-fire training would require a permit or be prohibited, since the fuel would be classed as a hazardous waste. Currently, however, waste JP-4 is not regulated, because unless it is mixed with used oil or solvent, it is not considered a waste. Unused material is not RCRA "solid waste" unless disposed. Further, use of used oil and fuel in firefighter training is not addressed in the EPA Regulation of Used Oil for Burning (29 Nov 85). Those facilities using new or uncontaminated JP-4 for firefighter training will not be regulated under RCRA.

4. <u>Superfund Amendments and Reauthorization Act</u> (SARA) of 1986 (Public Law 99-499) amended and extended the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (Public Law 96-510). SARA provides the framework for emergency cleanup of spills and hazardous wastes at abandoned and no longer operating hazardous waste facilities. Response action can be initiated on releases of a "hazardous substance or any pollutant or contaminant" which may present an "imminent and substantial danger" to the public health or the environment. In addition to the other Federal Acts listed above, SARA "hazards" include substances defined by the Clean Water Act, and Toxic

Substances Control Act. Thus, the range/scope of CERCLA or SARA "hazardous" substances is broader than that in RCRA.

To assist hazardous waste site investigators, planners and remedial action organizations, EPA's Cancer Assessment Group (CAG) has informally published ambient concentrations employing a 1:100,000 (10^5) risk factor (Jones and Dash, 1984, p. 16), for eight air pollutants. Some of these organic species are constituents of JP-4 and are probably emitted to the atmosphere during and after burn pit operation. Nearly without exception, unlined firefighter training facilities have shown a potential to contaminate groundwater aquifers with toxic organic compounds (trichloroethylene, dichloroethane, etc), and many are currently undergoing extensive remedial cleanup investigations. However, if new, or waste fuel (contaminated with less than 10% water or oil) is burned in the firefighter training facilities, RCRA/SARA are not applicable regulatory instruments since the fuel is not "waste" as currently defined.

B. State Air Quality Standards, Rules and Regulations

Environmental quality standards are also regulated at the State level. At this level, at least two types of regulatory instruments exist in all 50 states: State Implementation Plans of the National Clean Air Act, and State air quality statutes. Many states elected to adopt the NAAQS without any changes, while some adopted more stringent air quality standards for one or more of the NAAQS pollutants, and/or promulgated standards for specific pollutants in addition to those regulated by Federal air quality standards. Additionally, most states have established opacity standards for controlling visible emissions,

and some states have specific requirements pertaining to permits for and conducting open-burning for firefighter training. Open-burning is usually defined as any fire where the products of combustion are emitted into the open air and are not directed through a stack or chimney.

The SIP for any particular state consists of both the Federally approved State and/or local air quality regulations plus the Federally promulgated regulations for that State. Since State air quality regulations vary markedly in organization, language, and content, a standard format for preparing SIPs was provided by EPA. Firefighter Training comes under Section 51, Source Category Specific Regulations, Part 13 Open Burning (includes Forest Management, Forest Fire, Fire Fighting Practice, Agricultural Burning, and Related Topics). Typically, the verbage of the State statutes is identical to that of the SIP, the only difference being in the numbering and organization. Thirty-seven states have specifically included open-burning for purposes of training firefighters in their air quality rules, regulations or standards. Table 2.3 is a list of these requirements for the 37 states plus 2 counties in California. The North Carolina Air Pollution Rules, Section .0520, Control and Prohibition of Open Burning, contain some of the more detailed requirements and restrictions for live-fire training. The North Carolina statute acknowledges that open-burning for firefighter training is in the public interest, but specifically prohibits setting training fires for refuse disposal or recovery of salvageable material. North Carolina also requires disclosure of the location of burn, nature of material to be burned, amount of material to be burned, training objectives, and schedule of dates and times of the

Table 2.3

Regulation of Open-Burning for Firefighter Training

State	Firefighter Training Included in SIP and State Regs	Specific Open-Burning Firefighter Training Requirements
Alabama	yes	none
Alaska	yes	written approval
Arizona	yes	written declaration
Arkansas	yes	limitations
California	not specifically	varies w/county
San Bernardino	yes	permit & limitations
San Diego	yes	permit & limitations
Colorado	yes	exempted
Delaware	yes	written request
Florida	yes	advance notification
Hawaii	yes	opacity standard
Idaho	yes	exempted w/conditions
Illinois	yes	permit
Indiana	yes	prior approval
Kansas	yes	prior approval
Louisiana	yes	exception w/conditions
Maine	yes	permit w/conditions
Maryland	yes	concurrence
Massachusetts	yes	approval
Michigan	yes	prior approval
Mississippi	yes	none
Missouri	yes	exempted
Montana	yes	conditions
Nebraska	yes	exception
Nevada	yes	concurrence
New Jersey	yes	conditions
New Mexico	yes	permit w/conditions
North Carolina	yes	permission w/conditions
North Dakota	yes	local authorization
Ohio	yes	written permission
Oklahoma	yes	local authorization
Pennsylvania	yes	exception
South Carolina	yes	local authorization
South Dakota	yes	local authorization
Texas	yes	local written authorization
Utah	yes	permit
Virginia	yes	conditions
Washington	yes	exception w/approval
Wyoming	yes	written request

exercise. The complete text of the North Carolina statute is in Appendix E.

C. County and Local Air Quality Regulations and Rules

As shown in Table 2.3, several states grant local governing bodies the authority to approve, restrict or impose limitations on live-fire firefighter training facilities and their operation. Most requirements for pre-burn notification and coordination are regulated by the local agency having jurisdiction over the location of a specific Air Force base. California and Illinois have divided their air quality statutes into separate sections encompassing from one to several districts in each section (Bradley, 1986). These sections are tailored to consider specific regional requirements and conditions that impact open-burning.

With respect to RCRA and SARA regulations, states (with the exception of California), counties, and local pollution regulatory agencies have not promulgated their own hazardous waste or remedial action regulations. State and local regulations are not required by RCRA or SARA as they are by the CAA. It is unclear in DOD at this time as to whether state or local hazardous waste rules and regulations would apply. However, DOD in an Environmental Policy Memorandum (30 May 86) stated:

> Where state and local requirements other than those which are part of an EPA approved program call for management of waste as though it were hazardous, DOD policy is to comply to the extent feasible.

D. Overview of USAF Environmental Protection Program

1. Responsible Officials

The Base Commander at each and every Air Force base is ultimately

responsible and accountable for the installation's Environmental Protection Program. The commander has several staff officers with the necessary education, training and expertise, as well as a base level Environmental Protection Committee (which he chairs) to support him, provide technical advice, and conduct the Environmental Protection Program. This group reviews environmental policy, facilitates coordination, and serves as a steering group to monitor the overall environmental protection program (AFR 19-8). The members are to insure that every effort is made to conform to national environmental laws and regulations. The committee is to provide a critical evaluation of environmental concerns raised by proposed base actions. In addition to the Base Commander, the committee at each installation level normally is comprised of primary and alternate members from:

Civil Engineering
Environmental Planning
Natural Resources
Surgeon
  Bioenvironmental Engineer
Logistics
  Fuels Management
Operations
Plans

Staff Judge Advocate
Public Affairs Office
Comptroller
Personnel
Requirements
Staff Weather Office
Safety Office
Tenant Organizations

The staff officers with primary responsibility for conducting and monitoring installation level environmental protection programs are the Civil Engineering Environmental Protection Officer (EPO), designated by the Deputy Chief of Staff for Engineering and Services, and the Bioenvironmental Engineer (BEE), usually assigned to the Director of Base Medical Services. In general terms, the EPO is responsible for and primarily concerned with compliance with all applicable environmental pollution laws and regulatory agency requirements (national, state, county and local jurisdictions). The BEE, on the other hand, is

primarily concerned with the human health and environmental quality aspects of base activities. Other staff officers on base usually have less direct involvement with the USAF Environmental Protection Program, but do have important technical and administrative support roles, eg. Staff Judge Advocate, Staff Weather Officer, Public Affairs Officer.

This same basic military organizational structure ("chain of command"), used to conduct many programs (including environmental protection) at base or installation level, is also found at Major Air Command (eg. regional management offices) and Headquarters United States Air Force (eg. corporate executive offices), upper level management centers.

2. Air Force Policy, Regulations and Publications

Official USAF Policy is to take an active part in community and environmental planning and interagency and intergovernmental coordination (AFR 19-9, 1986). Executive Order 11752 states: "...it is the intent...that the Federal Government in the design, operation, and maintenance of its facilities shall provide leadership in the nationwide effort to protect and enhance the quality of our air and water resources" (AFR 19-2, 1982). Thus, USAF, an agency of the Executive Branch, has the responsibility for the prevention, control, and abatement of air and water pollution at its installations.

Specific environmental policies include the following: 1) eliminate or control environmental pollutants generated or resulting from USAF operations, 2) initiate and support local community pollution abatement programs, 3) provide environmental control measures in all designs for new or modified facilities, projects, exercises, and

operations, 4) provide preventive pollution control, 5) comply fully with the most stringent of all USAF, federal, state, and local environmental standards, 6) assess environmental consequences of proposed actions at the earliest practical stage of planning, 7) coordinate environmental matters with federal, state, and local pollution regulatory agencies, and 8) give top priority to situations that are hazardous to human health in accomplishing pollution control when resources are limited.

a. Air Force Regulation 19-2, Environmental Impact Analysis Process, implementing the National Environmental Policy Act of 1970, (NEPA) is applicable to all Air Force organizations and requires an Environmental Impact Analysis be conducted for all proposed projects, programs, tests, and exercises not exempted because of an overriding concern for national security or defense. This includes proper environmental impact assessment and documentation of possible adverse impacts associated with siting, construction, and operation of new Firefighter/Crash-Rescue Training Facilities. This formal upper-level management decision-making process is documented as a "Finding of No Significant Impact," "Environmental Assessment," or "Environmental Impact Statement." These documents are used by officials making the decisions or recommendations on whether and how to proceed. This procedure requires an understanding of the potential environmental consequences of any proposed Air Force action or alternative to the proposed action (AFR 19-2, 1982).

b. Air Force Regulation 92-1, Fire Protection Program, Chapter 3, "Fire Protection Training" also pertains to all Air Force installations and presents the proficiency training, training exercise

and live-fire operational requirements.

> "Use aircraft, vehicular gasolines, jet fuels or other hydrocarbon fuels for training fires. Do not use fuels for training purposes that contain more than ten percent by volume of oils or lubricants. Do not use fuels for fire training purposes that contain polychlorinated Bl (sic) phenyls or solvents and chemicals tha are defined as hazardous wastes by he US Environmental Protection Agency's Hazardous Waste Management System Regulations (40CFR Part 261).
>
> ... The quantities of fuel used in training fires must be realistic, controlled, and allowed adequate preburn times. The area or surface exposed to the fuel determines quantity of fuel required and the magnitude of the fire. A 300 to 500 gallon spill to simulate a fire situation involving approximately 3000 square feet, or 600 to 900 gallons for 7000 square feet is considered adequate. Prewet the fuel spill area with water to aid in fuel distribution. To simulate engine fires or other localized fire situations, 50 to 100 gallons of fuel is usually adequate. A 20 to 30 second preburn time is adequate for most live training exercises.
>
> ... Maintain coordination with local area air pollution authorities concerning scheduling of live training fires...."

The frequency of firefighter live-fire training required by Air Force regulations is: quarterly for military apprentice firefighters (Air Force Specialty Code 57130) and semiannually for experienced military firefighters (AFSC 57150/57170). Civilian USAF firefighters receive upgrade and periodic refresher training at similar training frequencies. The fire chief, deputy chief, and assistant chiefs are exempt from all fire department recurring proficiency training. AFR 92-1 also specifies that at least one live-fire exercise, using major crash firefighting vehicles, will be conducted annually during the hours of darkness.

c. Air Force Pamphlet 19-7, Environmental Pollution Monitoring, Paragraph 3-15, presents the following guidance for use by

Air Force base level environmental and civil engineering personnel concerning siting and operation of firefighter training facilities. It is advisory rather than regulatory in nature.

> "Firefighting Training...as currently practiced, open fires are necessarily accompanied by the emission of smoke and evaporated fuel into the atmosphere. The frequency of training fires and the quantity of fuel used should be minimized. Visible smoke is the most obvious indication of air pollution to the general public. To minimize adverse reaction, the burn site should be located in a relatively remote area and the duration of fires should be short. Burning on an impervious pad or apron equipped with low curbs will reduce fuel evaporation if the residue remaining after the fire is extinguished can be pumped out for disposal as a waste oil. Burning is not to be conducted during periods of atmospheric stagnation or inversion which would interfere with the rapid dispersal of pollutants. Inquiries should be made concerning any state or local regulations which should be followed." (AFP 19-7, April 1985).

d. Air Force Regulation 161-33, Aerospace Medicine Program, requires air emission inventories to be documented and updated annually at all military installations. The USAF Weapons Laboratory developed the Air Quality Assessment Model (AQAM) for estimating emissions, predicting atmospheric dispersion of air pollutants, and preparing an air emissions inventory for training burn pits and all other mobile and stationary air pollutant emission sources on air bases (Naugle, 1975; Rote, 1975; Sickles, 1981).

To assist Bioenvironmental Engineers in preparing detailed air emission inventories and to help standardize the calculation of emissions, the USAF School of Aerospace Medicine, Brooks AFB, TX published USAFSAM Handout EH-114, Methods Manual for Calculating Air Pollution Emissions Inventories, October 1979. Chapter 2 provides guidance for dealing with Firefighter Training Fires and provides process description, on-base sources of data, suggested emission factors

for non-abated JP-4 training fires, and sample calculations. The handout, not "regulatory" in nature, is part of initial technical training program for all Bioenvironmental Engineers in the Air Force.

e. <u>Defense Environmental Restoration Program</u>

The Department of Defense recognized the problem of hazardous and toxic materials, and took action to identify the locations and contents of past disposal sites and to eliminate the hazards to public health. The DOD CERCLA or "Superfund" program was called the Installation Restoration Program (IRP) at its inception. More recently, it is termed the Defense Environmental Restoration Program (DERP) and is contained in Section 211 of SARA (P.L. 99-499). Within the Air Force, Headquarters USAF Directorate of Engineering and Services, Washington DC has overall responsibility for the program. The Air Force Engineering and Services Center, Tyndall AFB, Florida provides technical and contract support for the IRP. Three Air Force Regional Civil Engineering offices (Atlanta, Dallas, and San Francisco) provide liaison between Headquarters USAF, AFESC, Major Air Commands, individual Air Force installations EPA regional offices, and State/local regulatory agencies.

DERP is subject to and is consistent with CERCLA, as amended by SARA. The Department of Defense program consists of four-phases in contrast to the EPA seven phase management approach. The IRP or DERP phases are: Phase I - problem identification, Phase II - confirmation, Phase III - technology development, and Phase IV - planning and implementation of control measures (<u>AF IRP Program Management Guidance</u>, 1985).

Reports of IRP Records Search activities were of particular importance to this study as a source of independently generated information about past and present firefighter training activities, base maps and facility locations ("Installation Restoration Program, Phase I - Records Search," various installations, 1981-1985). The records search conducted at each Air Force installation is an assessment of whether or not each past disposal site (including firefighter training facilities) pose hazards to the public health or environment from direct contact, migration to surface or ground water, or persistence of the contamination in the environment (Peters, 1985). The search entails an installation-wide study of written historical information and interviews with past and present personnel knowledgeable of past base operations (White, 1984).

CHAPTER III

ENVIRONMENTAL AIR QUALITY MANAGEMENT ALTERNATIVES

The firefighter training facility management alternatives identified in this research include: engineering controls, isolation of source, process modification, facility utilization, scheduling/planning, and combination of these alternatives (Figure 3.1). Each is examined for its potential to influence air emissions associated with burning aviation fuel for purposes of training and evaluating firefighter aircraft crash/rescue response.

A. Air Quality Management

Air Quality Management is the basis for air pollution control strategy in the United States. Air quality is "managed" to meet specific ambient or air quality standards or goals. In the United States, this strategy is anchored in NAAQS established for selected pollutants. The actual management occurs through regulation of the amount, location, and time of pollutant release (Stern, Volume V, 1977, p. 10).

If USAF Firefighter Training Facilities were operating within standards or where regulations and standards were not directly applicable, a philosophical goal of holding emissions to as low a level as possible and practical was used - good practice or best feasible practice. The term "practice" included not only air pollution control systems and control technologies, but facility design, siting, operation

Figure 3.1

Potential Environmental Air Quality Management Alternatives: Firefighter/Crash-Rescue Training Facilities

BASE, MAJOR AIR COMMAND, HQ USAF MANAGEMENT LEVELS

- CONSTRUCT NEW AIR POLLUTION CONTROLLED FACILITY
- INSTALL AIR POLLUTION CONTROLS ON EXISTING FACILITY
- DECREASE QUANTITY OF FUEL BURNED
- DECREASE NUMBER OF TRAINING FIRES
- RELOCATE FIREFIGHTER TRAINING FACILITY
- ADOPT GO/NO-GO METEOROLOGICAL BURN CRITERIA
- CURTAIL LIVE-FIRE TRAINING
- CONDUCT JOINT FIRE TRAINING WITH PUBLIC FIRE DEPARTMENTS
- EXTEND USE OF FACILITY TO OTHER TRAINING PROGRAMS

MAJOR AIR COMMAND AND HQ USAF MANAGEMENT LEVELS

- INCREASE MANAGEMENT ATTENTION
- STANDARDIZE AND REGULATE FACILITY OPERATING PROCEDURES
- CREATE A NATIONWIDE NETWORK OF REGIONALIZED TRAINING FACILITIES
- PHASE-OUT LIVE-FIRE TRAINING BY USE OF SIMULATORS/TRAINING AIDS

---

and use considerations. Similarly, "good" and "best feasible" were not restricted, in the usual sense, to pollution abatement/control equipment, construction, and operational/maintenance costs, but encompassed operator requirements, exercise realism, probability of implementation, and air emission reduction potential.

To effectively manage air quality, certain capabilities and information must be available to the environmental planner, manager, regulator and/or facility operator. Performance standards or goals must be measureable as an emission rate, operational frequency and throughput, or other definitive parameters. Air emissions data, either obtained by source testing or estimated by air emission inventory procedures, are needed to calculate individual occurrence or total annual emissions. Atmospheric dispersion estimation techniques must relate source emissions to air quality or potential exposures based upon probable/plausible local meteorological conditions. A method for measuring the success of air quality management initiatives must be available. Finally, air quality management alternatives or tactics designed to reduce or eliminate air emissions must be operationally acceptable, economically and technically feasible, and enforceable.

B. Candidate Air Quality Management Alternatives

1. Engineering Controls

The Air Force and Navy have teamed resources to develop and test smoke abatement systems for firefighter training facilities (Bock, 1975; Goldsmith, 1974; Waterman, 1970). The objective of the joint services research and development effort was to design a cost effective smoke abatement system for an open burning practice facility for base level utilization to train fire suppression personnel. The underground piped water spray system operated by injecting a highly atomized water spray a few inches above the surface of the burning fuel. The optimal water spray flow rate determined by engineering studies was 1 $lb/min\text{-}ft^2$ of fire area during the fire peak (Kwan, and Hamre, Sep 1981).

Quantitative studies of smoke abated and untreated JP-4 fires were conducted by the Air Force to estimate removal efficiencies and visible emission reduction. These tests were performed using a four feet square fire pan test apparatus that was specifically designed to be representative of much larger fires. Test results were ultimately used to calculate emission factors for particulate matter, carbon monoxide, and nitrogen oxide. The resulting emission factors for untreated JP-4 fires were included in the USAF Air Quality Assessment Model.

The engineering tests of the smoke abatement system concluded that: 1) significant reduction in emissions were obtained, 2) flame heights in excess of 10 feet were produced with no visible emissions, 3) emission reduction appeared to be a function of cooling the fuel surface thereby reducing the rate of vaporization, and 4) emission reduction was a function of water deposition rate and degree of atomization (Haney, and Ristau, May 1973, p. 20; Ristau and Lehman, 1975, p. 33).

The Air Force prepared and distributed to MAJCOM Civil Engineers a site selection guide, design analysis criteria, design specifications, design cost estimates and design drawings for an "Environmentally Acceptable Live-Fire Training Facility" (Martin Marietta, 1986). The goal of the new design is to improve ground water protection by lining the pit and containment and reuse of the effluent. The design analysis suggests that the optional smoke abatement system will provide a reduction in visible smoke but does not insure that air pollution standards will be met (Martin Marietta, 1986, Design Analysis, p. 2).

Engineering control options were not considered in the present research, because they: 1) rely heavily on successful competition in the Department of Defense budgeting/funding process, 2) are subject to

construction funding/scheduling delays, and 3) are based on a smoke-abatement control technology that may be unacceptable in some air pollution control districts.

2. Source Isolation and Facility Siting

This option examines the impact of locating firefighter training facilities in areas of the base with optimal atmospheric dispersion characteristics and the lowest potential for on-base and off-base population exposures. The site must be suitable for firefighter training and not unnecessarily restrict airfield mission and aircraft operations. Planners and managers should also consider other environmental consequences, such as groundwater and surface water contamination potentials, when selecting a site to relocate or construct a firefighter training facility. It is possible, that at a given Air Force base, there is no acceptable site for locating a live-fire training area. In these situations the option of training firefighters at a different air base, other DOD installation, or state/county training center may be preferable. Conversely, if a base is planning construction of a new training facility, the option of using it as a regional or Major Air Command training center could be considered.

3. Process Modification

The purpose of this option is to reduce or eliminate atmospheric release of pollutants by modifying the operation of the firefighter training facility. Total annual and individual training exercise air emissions can be reduced by decreasing facility material/fuel throughput. Facility throughput is a function of the number of training exercises and quantity of fuel burned during each training fire.

Fuel substitution at an aircraft crash-rescue training facility has been jointly investigated by the USAF and US Navy. The objective of the research was to find a fuel that would burn on a free surface with a cleaner flame than JP-4 or JP-5. The alternate fuels considered were aliphatics, ethers, esters, alcohols, and ketones. Six compounds showed promise in laboratory scale tests: n-hexane, n-heptane, n-butanol, n-pentanol, n-propyl acetate, and n-butyl acetate. Fire characteristics such as flame height, visibility, temperature and smoke density varied with each fuel. Some of these fuels did not produce luminous, visible flames. This posed a potential hazard to firefighters. These compounds were more difficult to extinguish or produced more smoke than the JP-4 or JP-5 fuel fires (Ristau and Lehmann, Dec 1975). The Air Force has not selected alternate fuels for open burn live-fire training for the above reasons, the higher cost of some alternate fuels, and they result in degradation of training realism. Since this control tactic has been extensively investigated, this option was not considered in this research.

Firefighter training simulators were considered as a management alternative. Navy programs to develop shipboard fire suppression training simulators have been conducted and evaluated (Booz, January 1981). The Navy training facility design and shipboard fire suppression scenario differed considerably from Air Force open pit aircraft crash/rescue training fire needs (Cummings, Branshaw and Owens, 1970). Since the Navy facility/simulator was fully enclosed with exhaust outlets or stacks, and used diesel or natural gas, it did not simulate the air emissions generated in the Air Force Fire Protection Training Program. Additionally, air pollution control systems and techniques for

a directed exhaust stream would not be suitable for an open burning operation.

4. Firefighter Training Facility Utilization

Air pollutant emissions on a per trainee basis could be optimized by maximizing the number of firefighters trained during each training burn. A larger number of persons could be trained while using less fuel per year. Evaluation of this alternative for a specific base should consider the local fire protection mission and the effective trainee capacity of the existing facility.

Expanding the use of a firefighter training facility to exercises by other special emergency response or environmental incident/recovery teams could increase the number of potential funding sources for construction and operations/maintenance expenses. As an alternative to constructing or using a variety of different training sites, other USAF required field training exercises, such as nuclear weapons accidents, oil/fuel spill recovery, hazardous materials accident response, and chemical warfare defense gas mask confidence training, could be conducted at the base's fire department live-fire training location. This concept should, reduce the cost per person trained by using one multi-purpose training area instead of multiple single purpose training facilities.

Designating selected military installations as regional or Major Air Command firefighter training facilities for use by many fire departments could decrease the total number of firefighter training fires, increase training efficiency, provide standardized training, and if located in areas with suitable atmospheric assimilative capacities,

reduce the combined potentials for adverse environmental or population exposures due to air emissions from training fires. Consideration could be given to joint-use of firefighter training facilities by emergency response teams from other branches of the Department of Defense, US Coast Guard, Department of Transportation, Environmental Protection Agency, and local airport and community fire departments. This option to expand the use of firefighter training areas to other teams, agencies, and departments, would potentially reduce the cost per individual trained, improve inter-service/inter-departmental cooperation, and promote base-community relations.

5. Scheduling/Planning Training Exercises

The preplanning of training exercises is another option for managing air emissions. This option could include local procedures for on-base and off-base agency coordination/notification, establishing meteorological burn/no-burn decision criteria, selecting an optimum time-of-day for fires, documenting and implementing facility operating procedures, initiating near-term record keeping and reporting to upper level management through existing environmental management channels, developing positive public affairs aspects associated with firefighter training exercises, and promoting joint military-public fire department facility use and training exercises.

A cooperative effort of several base organizations is required to schedule a training exercise to insure that air emissions do not violate pollution regulatory agency standards and that potential adverse effects are minimized. An understanding of fire department training requirements; facility operating parameters from which emission source strengths can be estimated; meteorological forecasting capability and

historical weather data; and a source-receptor model to predict air pollutant concentrations that can be interpreted by base medical personnel are required in a long-range firefighter training program. Factors such as inversion probabilities and wind conditions can be predicted seasonally or monthly from archived meteorological information to identify the best time for training burns.

These same factors can be used to select a live-fire training site that optimizes mission requirements and minimizes air pollution exposure potential. The primary meteorological parameters that determine atmospheric assimilative capacity are wind speed, wind direction, atmospheric stability, and mixing height. Historical airfield weather data generally includes these parameters and can be accurately forecasted on an hourly, daily, monthly or seasonal basis. Additionally, detailed flight conditions forecasting is done at daily regularly scheduled intervals at bases supporting a flying mission for purposes of flying safety and air operations effectiveness.

6. Combination of Management Alternatives

Air emissions of all pollutants associated with training crash fires could be reduced by combining one or more of these management alternatives. Emissions could be minimized through careful facility siting, design, exercise planning, coordination, and scheduling. Reducing the number of live fires, supplemented by simulator training, would also decrease air emissions associated with practice crash fires. Scheduling hazardous material or fuel-spill recovery team practice exercises following fire training burns could provide realism for both training groups. If the burn pit was decontaminated or used in as a

follow-on training session, the potential for adverse environmental consequences would be lessened. These options would only be restricted by installation facility limitations, personnel availability for training, and other mission requirements influencing use of the training area.

CHAPTER IV

RESEARCH METHODOLOGY

Chapter IV contains the research approach, study design, data collection methods, process, and plan of analysis. Criteria/rationale for installations surveyed, selection of study participants, and content of each questionnaire are presented. The plan for statistical treatment of the data was devised taking into account the descriptive rather than inferrential nature of this research, plus the fact that the entire study population was included in the original sample set. Assumptions and limitations associated with mailed questionnaire and interview research are also presented.

A. Approach and Research Design

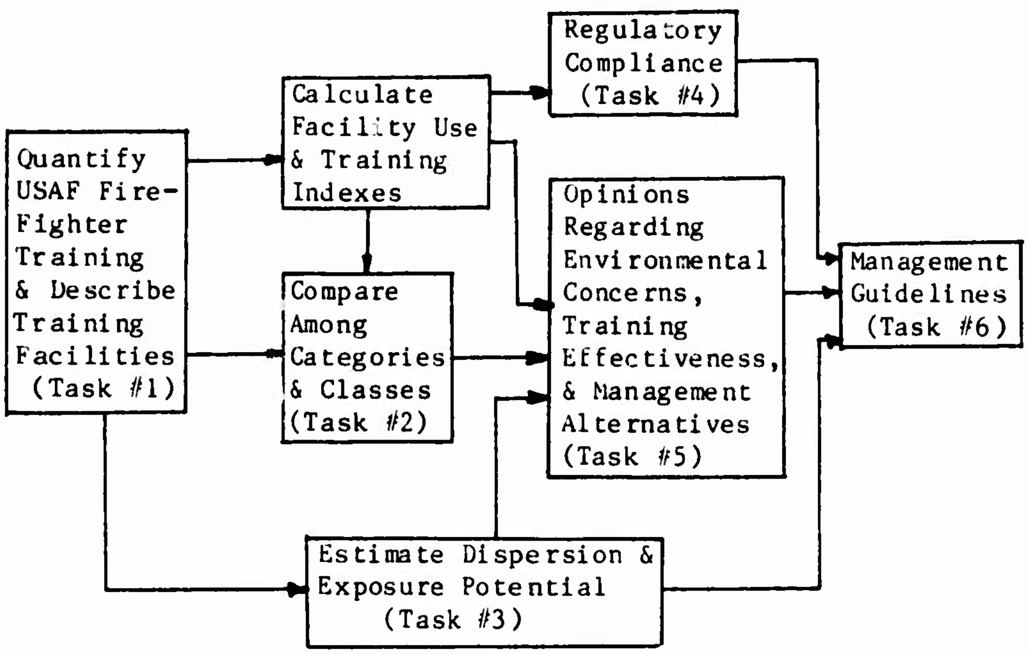
Two questionnaires and interview surveys were used to collect field data from Air Force bases nationwide. The first questionnaire was sent to all base level Civil Engineers requesting information about their fire departments. This instrument focused on the design, siting, operation and use of firefighter training facilities. Different questionnaires were sent to USAF Fire Chiefs, Environmental Protection Officers, and Bioenvironmental Engineers. The Phase II questionnaires were designed to investigate environmental regulatory compliance, collect attitudinal data about environmental impacts and firefighter training effectiveness, and measure opinions concerning the feasibility of air quality management alternatives considered in this study.

Site visits and discussions with study participants were made at twenty installation that were representative of the types of bases, missions, and installation locations in the Air Force. Additional information was collected from related studies, prior research and development programs, existing air quality and environmental data, historical facility operational data, and archived meteorological information. Figure 4.1 depicts the research protocol.

Figure 4.1

<u>Phased Research Protocol</u>

USAF Firefighter Training Facilities

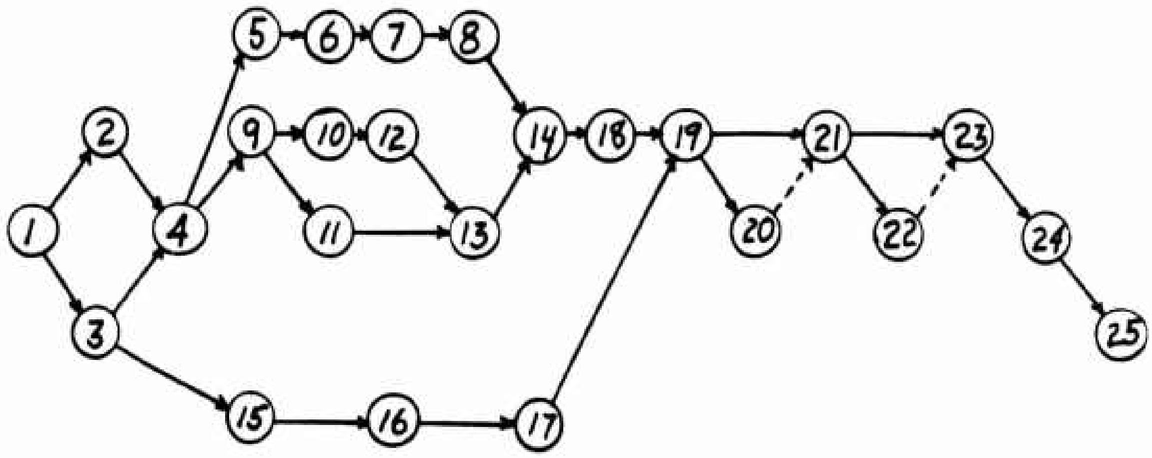


|<-------- Phase I -------->|<--- Phase II --->|<-- Output -->|

A detailed Program Evaluation and Review Technique (PERT) Network (Figure 4.2) was prepared to assist in design of the surveys used in this investigation.

Figure 4.2

PERT Network for Mailed Survey Program Phases



1. Determine Data Needs
2. Review Related Literature
3. Begin Item Construction
4. Plan Data Processing
5. Identify Survey Sample
6 Design Sampling Technique
7. Complete Mailing List
8. Complete Cover Letter & Instructions
9. Complete Questionnaire
10. Obtain Committee Review
11. Obtain USAF Approvals
12. Pilot Test Questionnaire
13. Make Needed Revisions
14. Reproduce Final Forms
15. Design Tabulation Method
16. Plan Analytic Techniques
17. Select Statistical Tests
18. Mail Questionnaires
19. Tabulate Initial Returns
20. Send 1st Follow-up
21. Tabulate Returns
22. Send 2nd Follow-up
23. Final Tabulation
24. Run Statistical Tests
25. Interpret Results

(adapted from: Orlich, Donald C., Designing Sensible Surveys, Redgrave Publishing Co, Pleasantville, NY, 1978, p 105-107)

B. Method.

The survey instruments were designed to be primarily descriptive. That is, they described and characterized where, how often, and what type of facilities were currently in use to train firefighters in aircraft crash/rescue response. A second survey sought information, attitudes, and opinions about factors related to environmental air quality management, environmental protection, and regulatory compliance.

1. Installations Studied

All major USAF bases, a total of ninety-two installations, in the contiguous United States, Alaska, and Hawaii were selected as candidates in the first phase of data collection. Criteria used to select bases for further study were, the base had to: 1) support a flying mission, 2) possess and operate an active flightline, or 3) operate fire protection services that conducted aircraft crash/rescue training. These exclusionary criteria reduced the original sample field from ninety-two to eighty-five bases. The selected eighty-five installations were located in forty different states, all ten EPA Regions, all Major Air Commands that support flying operations, and involved all sizes and types of military aircraft.

Geographical groups were created by combining EPA and Federal Emergency Management Agency national regions into three groups: I-IV, V-VII, VIII-X. Table 4.1 indicates the number of states and Air Force installations in each geographical group.

Eight nominal groups were used to categorize participating installations for analytical purposes. The nominal classes represented the type of military aircraft modeled or simulated at an installation's firefighter training facility. Classes 1 through 6 included specific types of military aircraft mockups fabricated for training use. Class 7 was used for bases where "No Aircraft" mockup was used. Class 8 included bases using an "other" mockup design, plus those bases that did not return a Phase I questionnaire and where mockup type could not be determined from other data or sources.

Table 4.1

USAF Installations by Geographic Division

	EPA/FEMA Regions			
	I-IV	V-VII	VIII-X	Total
Number of States in Region	21	15	14	50
Number of States with Bases	15	13	12	40
Number of Bases in Region	27	30	28	85

These classes, based upon type of aircraft mockup in use by the fire department (Bomber, Tanker, Transport, Fighter, Trainer, Rotary Wing), were developed to mask the identity of an installation's organizational mission orientation. For example, a base with a bomber mockup did not necessarily belong to a Major Air Command (MAJCOM) with a strategic bombing mission; similarly, a base using a fighter mockup did not always belong to a MAJCOM with a tactical air support or interdiction mission. Thus, this classification scheme maintained base anonymity.

The eight nominal classes of aircraft were reduced to three ordinal categories to facilitate cross-tabulation of large sample sizes, and improved accuracy by having a greater number of data points in each analytical division. The first two of the three categories representing relative size of mission aircraft, are comparable to standards and requirements in Air Force Regulation 92-1 pertaining to firefighter training facility design, use, and operation (Table 4.2).

Table 4.2

Mockup Classes and Categories

Type of Military Aircraft Simulated At Training Site	Nominal Mockup Class	Ordinal Study Category
Bomber	1	A
Tanker	2	A
Transport	3	A
Fighter	4	B
Trainer	5	B
Rotary Wing	6	C
Other	7	C
Non-Responsive Bases & Unknown Mockup Type	8	C

2. Study Subjects

Three different occupational groups or Air Force career fields were used as sources of information in this research: 1) Fire Chiefs or Assistant Chiefs for Training, 2) Environmental Protection Officers (EPOs) or Environmental Planners, and 3) Bioenvironmental Engineers (BEEs). These three professional specialties were selected because of their common inter-group formal education, military training, professional experience, authority, and overall job responsiblities. They are also directly involved with and responsible for operating, conducting, managing, coordinating, and monitoring firefighter training facilities and activities at base level.

Fire department personnel represent the firefighter training facility "user" or "operator". The fire department Chiefs and Assistant

Chiefs are usually senior enlisted personnel or career Civil Service employees assigned to the Base Civil Engineer (BCE). The EPOs are typically Company Grade Officers (rank of Lieutenant through Captain) who advise the Base Commander on matters dealing with the installation's compliance with federal, state, and local environmental regulatory agency regulations, standards, and requirements. There is one officer designated as the base's Environmental Coordinator or EPO, and like fire department personnel, this individual works for the BCE.

The base level BEE is a Company Grade or Field Grade Officer (rank of Major through Colonel) usually assigned to the Director of Base Medical Services (DBMS). The BEE must possess an engineering degree and works closely with the EPO and BCE, advising the base commander on matters concerning environmental protection and management. Unlike the EPO, whose primary focus is on regulatory compliance, the BEE is the commander's technical medical/environmental advisor on possible adverse human health or environmental consequences from proposed or on-going installation activities. At some installations, if it is an unusually large installation, large depot maintenance industrial mission, or research and development facility with test ranges, there would be more than one BEE assigned.

Three hundred forty-seven (347) surveys were sent to base level personnel in this investigation. This excluded first & second follow-up requests. Additionally, Fire Protection, EPO, and BEE counterparts at the Major Air Command management level, representing the next higher echelon of upper level management oversight, were also requested to complete abbreviated survey letters. Thus, 358 questionnaires were

mailed to 271 prospective study participants at 85 Air Force bases.

3. Survey Instrument

Professional opinions and evaluations of management alternative survey questions were designed using Likert ordinal scales. They are a continua of exhaustive mutually exclusive categories ranging from positive to negative. These scales have a hierarchical rank/order relationship between possible response categories. The intervals between categories are not, however, considered equal or to be precisely known. In this study five Likert ordinal scales were used: two positive, one neutral or no opinion, and two negative response categories. Numeric codes were assigned to each category as shown in Figure 4.3.

Figure 4.3

Likert Ordinal Scales

Response Category		Numeric Code
Strongly Agaree	Practical	5
Agree	-	4
Neutral	Neutral	3
Disagree	-	2
Strongly Disagree	Impractical	1

The use of computed means for Likert ordinal scale responses is useful and frequently done. When the same response scale and numeric code is used for several questions, it allows a rank ordering or prioritization to be made. This type of data interpretation facilitates comparing subgroups and categories more easily than by standard cross-tabulation techniques (Orlich, 1978, pp. 44, 50-59, 139-141).

Each respondent was asked to score his opinion on nineteen questions using the five point semantic differential rating Likert Scales. For each question a measure of central tendency was calculated by multiplying the total number of individuals making a like response by the numeric code for that response, and divided by the total number of individuals responding to that question. This yielded an arithmetic mean for each of the nineteen attitude/opinion type questions.

Further, as a measure of variability between respondent categories and questions, standard deviations were calculated. These were used as indices to compare consensus of opinion within a specific study group or category for a particular question.

Four different but standardized questionnaires were prepared for application to the three different subject groups. The Phase I questionnaire was administered to fire department personnel only. Its four sections were designed to collect information about the respondent, fire department size, training program, live-fire training facility location, design, use and operational parameters. The Phase II EPO and BEE mailed survey questionnaires were similar, with the EPOs concentrating on interaction with environmental regulatory agencies, and the BEEs focusing on air emission inventory procedures. The Phase II Fire Department survey form was designed as a follow-on to the Phase I instrument obtaining verification or clarification of responses given on the previous survey plus it requested attitudinal information.

All three Phase II instruments were standardized to the extent that they all had the same attitudinal response questions/items. Nineteen five point semantic differential rating scale items (Strongly Agree

through Disagree, or Practical through Impractical) were prepared for three subscales of interest: environmental concern, firefighter training effectiveness, and feasibility of candidate air quality management alternatives.

Some survey items were reworded, presented in a different format, and repeated in different sections of the form to check for respondent consistency. Also, to measure the extent of intra-base coordination and information exchange, identical questions regarding knowledge of common information were included in the three different surveys to the three subject groups. Copies of questionnaires used in this work are Appendices A.2, A.4, B.2 and C.2.

C. Survey Process

An Environmental Sciences and Engineering departmental letterhead transmittal letter explained the purpose of this Air Force sponsored research and requested support in conducting a survey of USAF Firefighter Training Facilities and activities. An instruction sheet was included with the cover letter.

Respondent identification was requested on the first page of each survey form to enable the researcher to contact the individual for possible future data clarification, telephone interview, site visit coordination, etc. To protect each subject's right to anonymity and to promote confidentiality, each base contacted in Phase I was assigned a unique identification number. The installation's identification number appeared in the upper left hand corner of each page. Printed at the bottom of each page was the Survey Control Number (SCN) and survey expiration date, assigned by Headquarters US Air Force to each survey

package approved for in this study. Assurance was given each potential participant that neither their name, nor the name of their base, would be used in any publications resulting from the research nor would it be released to any requestor.

The survey instructions also included a Privacy Act Statement in accordance with Air Force directives. The statement advised the prospective respondent that participation was voluntary, stated the survey's purpose, what the data would be used for, and that every installation's response was important to the overall accuracy and success of the survey effort. The phone number and address of the researcher was provided in the instructions in the event the respondent had any questions or needed additional information about the survey.

Phase I responses and other archived information were used to determine whether a base remained in the study. Bases were deleted if they did not support a flying mission, did not have an active flightline, or did not operate their own fire protection services. All deletions were done prior to finalizing the mailing list for Phase II.

D. Assumptions & Limitations of the Research Method

Using mailed surveys to collect information has inherent problems and limitations. There is no reliable mechanism to determine whether or not a subject really understood a written survey question. Pilot testing of survey forms and follow-up discussions with participants were used in this study in an attempt to minimize or overcome this possible effect. Additionally, any fire department responses to Phase I that appeared to fall outside expected responses, or where the questionnaire item appeared to have been vague or perhaps misunderstood by the

respondent, were restated and included for their verification and clarification in the Phase II Fire Department survey instrument.

Opinion researchers suspect there can be a "yes" tendency among mailed survey participants that can bias data (Orlich, 1978, pp. 38-39). A technique of varying yes/no sentence structure is believed to lessen the tendency to return "yes" answers. Questionnaires used in this investigation were structured to alter the presentation and wording of affirmative and negative response opportunities. Lastly, the researcher must assume in a mailed survey study that the respondent was the intended recipient and was qualified to answer the questions. There is little that can be done to evaluate the quality of the response, qualifications of the individual responding, or to determine if a committee or group of people filled out the questionnaire. This study, to overcome these potential problems, selected subjects that were career civilian professionals and military officers currently in positions of responsibility and authority that directly involved firefighter training, environmental air quality management, and environmental protection.

E. Analytical Plan

Study data included three professional groups, six mockup classes, three study categories, and three geographic regions. This categorical approach made it possible to make comparisons between installations and professional groups, within and between classes, categories, and geographical regions. An Apple IIe Computer with 512K RAM was used to tabulate and analyze all research information associated with this work. AppleWorks spreadsheet software was employed to create, manipulate, and

store the master database. Human Systems Dynamic's <u>Stats Plus</u>, a general statistical analysis software package for the Apple IIe, was used for statistical analyses (Madigan and Lawrence, 1982).

Since not all respondents completed every questionnaire item, nominal and ordinal data included in this study are reported as a ratio: specified response/total number of responses received for each question. For attitudinal response survey items, proportional frequency distributions were constructed, and ordinal value modes were determined. Attitudinal responses and opinion management alternatives were tabulated and summarized separately for each professional group and in one combined group for all participants in each Class, Category, Region, and total USAF. Data treatment and analysis is shown in Figure 4.4.

Figure 4.4

Phase I & Phase II Survey Data Analysis

Study Phase	Professional Group	All Bases	Mockup Class	Study Category	Geographic Region
	Type of Data / Statistical Treatment				
Phase I					
Fire Department		1 a	1 a	1 a	1 a
Phase II					
Fire Department	3,4 b,b	2,3,4 b,b,b	4 b	3,4 b	3,4 b
Environmental Protection Officer	3,4 b,b	2,3,4 b,b,b	4 b	3,4 b	3,4 b
Bioenvironmental Engineer	3,4 b,b	2,3,4,5 b,b,b	4 b	3,4,5 b	3,4,5 b

Legend:

Type of Data Collected

1 = facility design, use & operation
2 = measures of environmental management & coordination
3 = attitudinal responses
4 = feasibility of air quality management alternatives
5 = air emission inventory information

Statistical Treatment

a = arithmetic mean & standard deviation
b = response frequency & mode, mean & standard deviation

(ref. Orlich)

CHAPTER V

RESEARCH FINDINGS

Survey participation, Phases I and II questionnaire responses, upper-level management data, and site visits and interviews are summarized in this chapter. Findings are presented and discussed by the three professional categories as they relate to environmental impact, feasibility of alternatives, and opinions regarding current environmental air quality management of live-fire firefighter training. Also, included are regulatory knowledge, awareness, and compliance findings related to each group of professionals included in this research.

A. Mailed Survey Return Rates

All returned questionnaires were included in calculating the overall response rate regardless of the degree of completion. Some respondents did not participate in the study because they either felt they were too inexperienced, or they had arrived at their current installation such a short time ago that they had not become familiar with the material requested in the survey. Some respondents completed some but not all items.

1. Phase I

A Fire Department survey form was mailed to each of ninety-two major Air Force Bases in the contiguous United States, Alaska and Hawaii. The returns from this survey were used to select bases for

further participation in the study, and to categorize USAF bases. Seventy-nine (85.9%) fire departments returned the initial surveys.

Those bases that were not supporting a flying mission, and/or did not have an active flightline, and/or were not operating a fire protection service that conducted aircraft crash/rescue training were deleted from further study. Eighty-five bases were retained in the study. Three of the bases responding were not supporting a flying mission and did not have an active flightline, four did not have their own fire departments, and relied on local community fire departments for fire protection services. Of the eighty-five bases retained in the study, seventy-five (88.2%) had returned Phase I surveys. Table 5.1 shows Fire Department response rates by geographic regions.

Table 5.1

Phase I - Fire Department Survey Return Rates

	No. USAF Bases in Region	No. Bases Returning Survey	Questionnaire Return Rate
EPA/FEMA Regions			
I-IV	27	24	88.9%
V-VII	30	27	90.0%
VIII-X	28	24	85.7%
Totals	85	75	88.2%

Each base whose fire department returned a Phase I mailed survey was grouped according to the type of mockup aircraft used at the live-fire training facility. Each of the six types of military aircraft mockups used to train firefighter crash/rescue personnel were assigned to Classes 1 through 6, bases using no aircraft mockup were placed in

Class 7, and bases other than these in "Other" (Class 8). Since only one installation reported using a rotary wing firefighter training mockup, Mockup Class 6 was combined with the Class 7 bases into one Class 6/7. Since none of the bases used anything but military aircraft mockups, Class 8 was used for bases that did not return Phase I questionnaires or where the mockup type could not be determined from other sources.

The remaining seven mockup classes were grouped into three broad categories to increase sample size for analysis. Category A included bases reporting either bomber, tanker, or transport sized firefighter training mockups (Classes 1,2,3). Category B was used for bases reporting fighter or trainer sized aircraft crash/rescue mockups (Classes 4,5). Category C was used to describe bases with rotary wing or no aircraft mockups in use, plus those bases that did not return the Phase I survey and mockup type could not be determined from other sources (Classes 6/7,8). This classification scheme is shown in Table 5.2.

Table 5.2

Base Classification

Class Number	Aircraft Mockup Type	No. Bases in Class	Study Category	No. Bases in Category
1	Bomber	11	A	
2	Tanker	12	A	44
3	Transport	21	A	
4	Fighter	22	B	29
5	Trainer	7	B	
6	Rotary Wing	1	C	
7	No-Mockup	3	C	12
8	Unknown	8	C	
	Total	85		85

2. Phase II Response Rates

Mailed surveys were sent to three different groups of Air Force professionals: Medical Service Bioenvironmental Engineers, Civil Engineering Environmental Protection Officers, and Civil Engineering Fire Protection Services personnel at the 85 bases included in the study. Table 5.3 presents the questionnaire return rates for each professional group by: Mockup Class, Study Category, and all groups combined and Table 5.4 the same information by geographic region.

Table 5.3

<u>Phase II - Survey Return Rates By Study Category</u>

Firefighter Training Aircraft Mockup Class/Category

Class	1	2	3	4	5	6/7	8	Total
No. Bases	11	12	21	22	7	4	8	85
Category	A			B		C		
No. Bases	44			29		12		

Ratio of Surveys Returned/Percent

	1	2	3	4	5	6/7	8	Total
No. of Surveys Returned by Bioenvironmental Engineers	9/11 81.8%	11/12 91.7%	10/21 47.6%	18/22 81.8%	6/7 85.7%	3/4 75.0%	7/8 87.5%	64/85
	30/44 68.2%			24/29 82.8%		10/12 75.0%		75.3%

Ratio of Surveys Returned/Percent

	1	2	3	4	5	6/7	8	Total
No. of Surveys Returned by Environmental Protection Officers	10/11 90.9%	10/12 83.3%	18/21 85.7%	15/22 68.2%	7/7 100%	3/4 75.0%	7/8 87.5%	70/85
	38/44 86.4%			22/29 75.9%		10/12 75.0%		82.4%

Ratio of Surveys Returned/Percent

	1	2	3	4	5	6/7	8	Total
No. of Surveys Returned by Fire Department Personnel	8/11 72.7%	8/12 66.7%	13/21 61.9%	15/22 68.2%	3/7 42.9%	3/4 75.0%	2/8 25.0%	52/85
	29/44 65.9%			18/29 62.1%		5/12 75.0%		61.2%

	1	2	3	4	5	6/7	8	Total
Total Number of Surveys Sent Out	33	36	63	66	21	12	24	255
	132			83		36		

Ratio of Surveys Returned/Percent

	1	2	3	4	5	6/7	8	Total
Total Number of Surveys Returned	27/33 81.8%	29/36 80.6%	41/63 65.1%	48/66 72.7%	16/21 76.2%	9/12 75.0%	16/24 66.7%	186/255
	97/132 73.5%			64/83 77.1%		25/36 69.4%		72.9%

Table 5.4

Phase II - Survey Return Rates by Geographic Region

EPA/FEMA Geographic Regions

Regions	I-IV	V-VII	VIII-X	Total
No. Bases in Rgn	27	30	28	85

	Ratio of Surveys Returned/Percent			
No. of Surveys Returned by Bioenvironmental Engineers	17/27	24/30	23/28	64/85
	63.0%	80.0%	82.1%	75.3%

	Ratio of Surveys Returned/Percent			
No. of Surveys Returned by Envir Prot Officers	24/27	24/30	22/28	70/85
	88.9%	80.0%	78.6%	82.4%

	Ratio of Surveys Returned/Percent			
No. of Surveys Returned by Fire Department	15/27	14/30	23/28	52/85
	55.6%	46.7%	82.1%	61.2%

Total Number of Surveys Sent Out	81	90	8[illegible]	255

	Ratio of Surveys Returned/Percent			
Total Number of Surveys Returned	56/81	62/90	68/84	186/255
	69.1%	68.9%	81.0%	72.9%

3. Site Visits

Twenty installations were visited during the course of this research. Initial site visits were performed to pilot test and refine the Phase II questionnaire by interviewing Bioenvironmental Engineering, Environmental Protection, and Fire Prevention personnel. Follow-up site visits were used to supplement or clarify data included in questionnaires. In some cases, field visits were used in lieu of mailed surveys. To reduce bias no bases were visited solely to encourage participation in the study. Table 5.5 shows site visits by Study Category and Geographic Region.

Table 5.5

Phase II - Site Visits by Study Category

Study Category	A	B	C	Total
No. Bases Visited	12	8	0	20

Phase II - Site Visits by Geographic Region

Geographic Rgns	I-IV	V-VII	VIII-X	Total
No. Bases Visited	10	7	3	20

B. Phase I Findings

1. Facility Design

Eight (10.4%) of seventy-seven USAF firefighter training facilities 10.4 are equipped with smoke abatement systems. These facilities were put into use between 1972 and 1983. Since 1972, forty-four burn pits were built or first used on sixty-eight air bases. A visit was made to

one installation in the process of building a new smoke-abated live-fire training area. Approximately twenty-six percent (19 of 74) of the burn surfaces were above concrete pads, and eighty-six percent (63 of 74) were equipped with underground fuel dispensing systems.

Most bases measured the quantity of fuel put into the burn pit for training. Measuring, versus estimating, was done three different ways: flow meter on the fuel truck servicing the training pit, flow meter on the fuel pump from the storage tank, or metering stick on the fuel storage tank at the site.

Fifteen (22.4%) of the fire training areas were located less than 1000 feet from the installation boundary, and an additional forty-five (67.2%) between 1000 feet and one mile from the base boundary. Twenty-two (32.8%) fire departments identified off-base populated or visited areas located within one mile of the burn area. On-base buildings or frequently visited areas within one mile of the firefighter training areas were reported by sixty (89.6%) fire departments (Table D.1 in Appendix D).

2. Facility Use

During this investigation, nine (11.7%) of seventy-seven Air Force installations were not conducting the live-fire portion of the firefighter training program because their training areas were closed for environmental, health, or safety reasons. At some bases, multiple environmental concerns were responsible for the base commander's decision to cease live-fire training activities.

Twenty-two bases were permitting Air Force fire departments from other bases to use their training facility. Thirty-five bases were allowing local public fire department personnel to train at their

facilities. Thirteen (17.3%) fire departments reported that they allowed both other Air Force and public fire department personnel to conduct live-fire training on their base. The majority (60.8%) of the fire departments usually conduct training burns in the morning hours. Seven installations indicated they usually burn practice fires after 6 PM; of those, four bases typically burn at 7 PM (near or after darkness).

The number of aircraft crash/rescue training fires conducted by any individual fire department varied from a low of four to a high of 134 fires per year. The quantity of fuel burned per training fire ranged from 100 to 2000 gallons based on information received from seventy-three fire departments. Each year these bases average 25.8 training fires with 502.2 gallons of fuel per fire.

A typical fire department averaged about forty-two military plus thirty-one civilian firefighters. On the average, nearly 88% of the firefighters represented in this study receive live-fire training annually. The frequency of training for each firefighter varied from two to twenty-eight times per year, with a mean of 5.5 live-fire training experiences annually at the seventy-four fire departments providing information. Responding fire departments reported training from three to sixty-five individuals per fire. The overall average for all bases returning a Phase I questionnaire was fifteen individuals trained per live-fire exercise. Summaries of this data are shown in Table D.2 (Appendix).

3. Facility Operation

Jet Petroleum Fuel (JP-4) is utilized almost exclusively for

aircraft crash/rescue firefighter training at bases included in this study. Many fire departments (46.0%) report burning only new or uncontaminated JP-4 in their training fires. Twenty-seven (47.4%) of fifty-seven fire departments reported testing fuel for impurities prior to using it for practice fires. Of the forty fire departments using waste JP-4 (contaminated with less than 10% oils and lubricants) for live-fire training, twenty-three (57.5%) tested the fuel in a laboratory prior to burning.

Based on the Phase I information, the typical training fire burned for 1.7 minutes before being extinguished by the firefighters. This time varied from eighteen seconds to five minutes for a single training fire. Twenty-five fire departments reported they re-ignite the same fuel pool more than once. The largest number of re-ignitions of the same fuel pool was ten.

Data summaries are presented in Table D.3 (Appendix).

C. Phase II Mailed Survey Findings

Phase II surveys were designed to gather information about environmental management practices, awareness and compliance with environmental regulations, involvement with pollution regulatory agency officials, and professional attitudes and opinions.

1. Environmental Protection Officers

In addition to gathering attitudes and opinions concerning environmental consequences, training effectiveness, and feasibility of air quality management alternatives, the EPO Phase II questionnaires were designed to measure each participant's involvement with environmental impact analysis and pollution regulatory aspects of live-

fire training facilities and their use. There were also questions related to construction costs, operations and maintenance expenses, and the source of engineering design drawings for the current or future proposed fire training facility.

a. Environmental Impact Analysis

Sixty-seven Environmental Protection Officers (EPOs) were asked whether or not environmental impact assessment documentation had been prepared on the current fire training area: 31% answered yes, 40% no, and 28% replied they did not know. One Environmental Impact Statement was found in the literature. Final Environmental statement for 1550th Air Training and Test Wing (MAC), Hill AFB, Utah, 16 Jul 1971, AFES 71-1F, Department of the Air Force, Washington D.C., Director of Civil Engineering that had been prepared in 1971 for a proposed fire training area in EPA Region 8. Some respondents commented that their training areas were in use prior to the National Environmental Protection Act of 1970, and thus an impact assessment was not required.

b. Environmental Protection Coordination and Activities

Fifty percent of the EPOs reported that each fire department training fire was coordinated with the local Pollution Regulatory Agency (PRAgncy) prior to burning. Twenty-one percent reported training fires were never coordinated with PRAgncy officials, and eleven percent stated they did not know if coordination occurred prior to each practice fire. Similarly, when asked if each training fire was coordinated with their office prior to burning, one-third answered that prior notification always occurred (100%), frequently (>50% but <100%), or occasionally (>0% but <50%). Two-thirds of the EPOs replied they were never notified about training burns. Forty-four percent of the EPOs had not observed a

live-fire training exercise at their installation's facility. Nine out of sixty-four EPOs had received complaints about facility operation, and 33 (53%) responded that Federal, State or local PRAgncy officials had made inquiries about their base's firefighter training facility. Almost 90% of the EPOs answered that guidelines and criteria in AFR 92-1 were used to accept or reject waste fuel for training fires. Table D.4 (Appendix) presents EPO Phase II response data.

Construction cost and annual expense information was provided on thirty-five out of sixty-four returned questionnaires. The average firefighter training facility, for which information was available, cost about $174,000 to construct, and $50,000 per year to operate and maintain. New facility construction costs were estimated to be on the average $724,000 (Table D.5, Appendix).

Forty-eight EPOs reported the source of the engineering design for their current facility; two bases had used AFM 88-15 standard design and engineering drawings or the AF Engineering and Services Center design package; eleven bases used a MAJCOM design package based upon the AF standard design; twenty-two bases had designed their live-fire aircraft crash training facility in-house using local resources; thirteen EPOs reported they did not know the source of their facility design. Table D.5 contains the cost information submitted as part of the EPO surveys.

Eighteen EPOs reported that their bases planned to construct new fire department training facilities. Ten of the eighteen were using either AFM 88-15 or AFESC plans and drawings, one used a MAJCOM design package, four did not know the source of the design, and none reported

an in-house design effort.

2. Bioenvironmental Engineers

The Phase II survey forms were tailored to collect specific data about each BEE's involvement and activities related to their base's firefighter training facility use, operation, and potential air pollution impacts. Each Bioenvironmental Engineer was requested to send a copy of the most recent Air Emissions Inventory with the completed questionnaire.

a. Regulatory Awareness Factors

Sixty-four BEE questionnaires were returned. Fifty-five percent of the BEEs did not know if the state in which the base was located had a State Implementation Plan (Clean Air Act) which specifically addressed open burning for the purposes of training firefighters. Similarly, twenty-seven percent did know if their installation was located in an EPA Clean Air Act designated Non-Attainment Area. Eighty-five percent of the BEEs reported that they never reviewed results of laboratory testing of waste fuels to be burned at their fire training area. No bases reported having done any source sampling or atmospheric dispersion modeling of pollutants released during practice fires. Three engineers out of fifty-seven reported that their offices had received complaints concerning firefighter training facility operation. Twenty-five percent had been contacted by PRAgncy personnel from federal, state, or local offices concerning the live-fire facility. Table D.6 (Appendix) contains Bioenvironmental Engineering Regulatory Awareness data.

b. Air Pollution Emission Inventories

Each BEE was asked to provide a copy of the most recent Air

Emission Inventory (AEI) with their completed questionnaire. A total of fifty-nine AEIs were obtained: fifty-three were returned with the surveys, five were obtained through NTIS (Artiglia, Pease AFB, 1983; George AFB, 1983, Edwards AFB, 1984; Pease AFB, 1985; OEHL, Vandenberg AFB, 1983) and one was obtained through the USAF Occupational and Environmental Health Laboratory (OEHL) Brooks AFB, TX (Artiglia, McConnell AFB, 1985). Five of the six AEIs received through NTIS and OEHL were performed by USAF consultant BEEs from OEHL upon receipt of a request initiated by the installation BEE. OEHL consulting engineers utilized a mainframe computer program, the USAF Air Quality Assessment Model, to produce annual air emission inventories. One AEI had been conducted by a consulting environmental engineering firm on contract to the base (Vandenberg Emission Survey, 1983). Six BEEs responded that an AEI had never been compiled for their installation. One inventory was reported to be in process, and all AEIs obtained were conducted since 1980.

Of the fifty-nine AEIs reviewed in this study, eleven did not include estimates of air emission from firefighter training activities. Fifty-two of the inventories had been prepared using emission factors and techniques contained in the USAF School of Aerospace Medicine, Handout EH-114, "Methods Manual for Calculating Air Pollution Emissions Inventories". The one AEI prepared by a contractor and five BEEs reported they had used HEW AP-42 emission factors to estimate annual emissions from live-fire training ("Compilation of Air Pollutant Emission Factors," Third ed., AP-42, Sep 1985).

The AEIs indicated training fire frequencies ranging from four to

120 times per year with 50 to 1000 gallons of fuel per training fire. Nine bases reported the total quantity of fuel burned per year for firefighter training, rather than reporting frequency and quantity information as requested. One base reported the total estimated annual emissions due to live-fire training but did not disclose the emission factors used, training frequency, or quantities of fuel burned. BEE estimates of total annual air emissions from individual fire training facilities ranged from 2 to 1424.7 tons/year with a mean of 83.7 tons/year per base. Two AEIs were received from bases having a firefighter training facility equipped with a waterspray smoke abatement system. Neither had taken into account emission reductions from the smoke abatement system. Table D.7 (Appendix) summarizes BEE Air Emission Inventory data.

3. Fire Department

Fifty-two Phase II questionnaires were returned by Fire Chiefs and Assistant Chiefs for Training. Table D.8 (Appendix) contains summaries of Phase II Fire Department survey responses.

a. Written Procedures

Just over one-half of the respondents indicated that their base had written environmental protection procedures or written policies pertaining to the firefighter training facility. Twenty-five percent of the bases acknowledged that their supporting MAJCOM had issued supplemental environmental protection guidelines relevant to live-fire training. A similar percentage did not know if supplemental guidance had been issued by their MAJCOM.

b. Training Effectiveness

Eleven participants stated they had personally experienced

training at a smoke abated live-fire training facility. Of those eleven, five believed that smoke abated fire training was acceptable, four felt it was unacceptable, and two had no opinion. Fire chiefs were asked to identify the most important characteristic of an acceptable fire training environment. Realism was the primary concern of all respondents to this question. Specific characteristics, including dense smoke, flames, intense heat, and fire size, were mentioned, but no single feature was identified as being most important. One recipient described live-fire exercises as being necessary to train and demonstrate the ability to lay down an efffective blanket of fire suppression foam on the burning fuel - "put the white stuff on the red stuff."

c. Coordination Procedures and Complaints

All responding fire departments (100%) indicated they coordinated with other base agencies prior to holding training fires. Typical on-base agencies notified included: control tower, base operations, command post, and the hospital. Also mentioned by some participants were: security police, civil engineering, bioenvironmental engineering, weather, safety, or public affairs personnel. Sixty-three percent of the responding fire departments answered that they coordinated each live-fire exercise with local PRAgncy officials either always or frequently, and twenty-nine percent never notified local regulatory officials. Nine fire departments reported having received complaints about firefighter training facility operation.

4. Responses To Identical Survey Items

Phase II questionnaire items were grouped for all three classes of

professionals.

a. Environmental Impact Considerations

All participants were asked to respond to the same questions dealing with their beliefs and attitudes concerning environmental consequences resulting from live-fire training exercises. Questions were formatted as multiple selection opportunities using semantic differential rating scales, and statements of significance or insignificance with respect to environmental impacts and consequences. Respondents were asked to check those statements they believed were most accurate with respect to their installation's aircraft-crash/rescue firefighter training program (Tables D.9-D.13, Appendix).

(1). Significance of Air Emissions

The three groups of professionals were asked if they believed emission of air pollutants from practice fires was significant or insignificant. Specific pollutants listed for respondent's consideration were: particulates, carbon monoxide, NO_x, SO_x, ozone, hydrocarbons, and lead. Forty-seven EPOs (73%), forty-three BEEs (77%), and twenty-four Fire Chiefs or Assistant Chiefs (57%) responded to the questionnaire item. Of all responses to the paired choice of significance or insignificance ot air pollution emissions, sixty-two percent of fire chief responses believed air emissions were significant. The other two groups did not think emissions were as significant as fire chiefs. Overall, about forty-four percent of the response indicated that air emissions from live-fire facilities were significant.

(2). Groundwater Contamination Potential

Subjects were also asked whether they felt groundwater contamination potential from practice fire areas was significant.

Fifty-five (86%) EPOs, thirty-four (61%) BEEs, and thirty-four (81%) Fire chiefs answered this question. Fifty-five percent of the EPOs and BEEs believing groundwater pollution potential was significant. The fire chiefs felt that potential groundwater pollution was less significant than air emission pollution potential.

(3). Air Quality Versus Groundwater Contamination Potentials

Participants were offered an opportunity to indicate whether they believed the potential to contaminate soil and eventually groundwater was far more significant than the potential adverse air quality impact resulting from firefighter training facility operation. Fire chief responses were consistent with their choices in the two previously posed pollution potential questions. The EPOs and BEEs disagreed with the fire department respondents which was consistent with their previous answers, that the potential for groundwater pollution was higher than the potential for adverse air quality impact from conducting training fires.

(4). Reducing Air Emissions From Live-Fire Training Facilities

Table D.12 (Appendix) contains the responses to a questionnaire item asking if the Air Force should take positive steps to reduce air emissions from all firefighter training facilities. The answers of the three study groups were nearly the same. Over fifty percent of all responses either agreed or strongly agreed with this statement. The fire chiefs felt slightly stronger about this approach, however, the EPOs and BEEs exhibited more consensus (lower standard deviation) in their responses.

(5). Environmental Or Public Relations Problem

Different responses were obtained to the statement that the "environmental problem" associated with firefighter training facilities is one of public relations rather than emission of hazardous levels of air pollutants. Fire department respondents (55.8%) and BEEs (39.6%) disagreed or strong disagreed, while EPOs (36.7%) either agreed or strongly agreed. The arithmetic mean of the BEE responses was higher, and had a smaller standard deviation than the other groups. The means of the three groups suggests that the overall opinion was below neutral and above disagree that the problem with live-fire training is not hazardous levels of air emissions, but it is rather one of public relations.

b. Training Effectiveness Opinions

Study subjects were asked to complete attitudinal response items by circling the value which most closely represented their opinion concerning training effectiveness with respect to firefighter training facilities. The same semantic differential rating scales (1 through 5) were included as answers to each question requesting opinions about firefighter training effectiveness. To permit assessment of the validity of individual responses, the fire department personnel were asked if they had received training at a smoke abated training facility, and the EPOs and BEEs were asked if they had observed an actual live-fire training fire at their base. Seventy-five percent of the responding Fire Chiefs or Assistant Chiefs for Training had never been trained in a smoke abated live-fire facility. Of the eleven Chiefs who had received training in a facility with a smoke abatement system, five assessed the training as acceptable, four believed it to be

unacceptable, and two offered no opinion (Tables D.14-D.17, Appendix).

(1). Observed Practice Fire

Fifty-five percent of the EPOs and seventy-five percent of the BEEs had not observed an actual practice burn conducted by the fire department at their base.

(2). Training Fires Without Smoke Abatement

Each study subject was asked to respond to the statement that only fires without air pollution controls can be used to adequately train firefighters. This item was designed to determine attitudes about whether smoke abated training facilities could be used to provide adequate training for firefighters or if natural untreated fuel fire environments were necessary. Agreeing with this statement meant that smoke abated practice fires would not provide adequate training and disagreeing vice versa. The EPOs reported a bimodal preference, either neutral or disagree. The arithmetic mean of the EPO responses were higher (more agreeable) than the BEEs or Fire Chiefs. Overall the three professional groups were either neutral or disagreed with the statement that only untreated fires can be used for adequate firefighter training.

(3). Importance of Smoke

Attitudes concerning the importance of smoke in a firefighter training environment were measured by scaled responses to the statement "that dense black smoke was the single most important characteristic for a training fire." Fire department respondents, with almost 79% recording Disagree or Strongly Disagree that dense black smoke was the most important characteristic expressed the strongest disagreement of the three groups. Additionally, as a group the Fire

Chief responses were more consistent than the EPOs and BEEs, having the smallest standard deviation.

(4). Performance In Real Fire

Professional opinions concerning training effectiveness in a smoke abated fire environment were also measured by asking study participants to evaluate the statement "that firefighter performance in real aircraft crash fires will not suffer because of training at smoke-abated facilities." The EPOs disagreed, the BEEs were neutral, but Fire Department personnel expressed agreement with this statement.

c. Feasibility of Management Alternatives

Study subjects were asked to draw upon their professional experience and expertise to evaluate the air quality management alternatives considered in this research. They were requested to evaluate the feasibility of the options as if each were being considered for implementation at their base's firefighter training facility. A five point semantic differential rating scale was used by respondents to score their opinions (Tables D.18-D.27, Appendix).

(1). New Facilities

Build a new smoke abated firefighter training facility was the first management alternative the participants were asked to evaluate. BEEs and Fire Chiefs rated this alternative between practical and neutral (4 on a scale of 5 to 1). The EPO response was below neutral (2) on the side of impracticality. The arithmetic mean of the combined responses was 2.86, with a standard deviation of 1.32, the group felt that building a new smoke abated training facility was not a practical air quality management alternative.

(2). Add Smoke Abatement System

Participants were also asked to evaluate the feasibility of adding air pollution controls to their existing firefighter training facilities in lieu of constructing an entirely new live-fire facility. Overall this option was scored lower (mean 2.54) than building a new smoke abated facility (mean 2.86).

(3). Burn Less Fuel

Burning less fuel was presented as a management alternative. The EPOs and BEEs scored this option between neutral and practical with an EPO mode of four, and the BEE response was bimodal with three/four. The Fire Chiefs rated this alternative as impractical.

(4). Train Less Often

Modifying training by decreasing the number of training fires per year was presented as a separate air quality management option. Similar to their response to decreasing the quantity of fuel burned, the fire chiefs felt that decreasing the number of practice fires was impractical. The EPOs and BEEs ranked this option on the practical side of neutral.

(5). Use Simulators

Another option was to develop and use firefighter training simulators to replace live-fire burn pits. The fire chiefs tended to reject this management alternative as being impractical. The other groups also ranked it on the impractical side but closer to the neutral region of the scale.

(6). Relocate Facility

Moving an installation's live-fire practice area to a remote area of the base was a facility isolation management alternative

presented to the participants. There was considerable variance within these professional groups. The EPO and fire chiefs felt that was impractical, while the BEEs were neutral. The feasibility of this option, as judged by the arithmetic means, was consistent between the groups. The combined mean score was just less than neutral.

(7). Send Firefighters to Training Centers

Sending firefighters away to regional centers for their periodic live-fire training was presented for feasibility evaluation by all participants. This management option was also considered to be a form of facility isolation even though it would require more than a local level management decision to implement. The BEEs scored this option as the most practical while the fire chiefs rated it as impractical. The combined average score was less than neutral for sending firefighters to regional facilities for training.

(8). Serve As A Training Center

Another management option was whether the subjects believed that having their base serve as a regional training center was practical. Fire Chiefs opposed this alternative more strongly than did the other participating groups. The BEEs and EPOs were neutral while the Chiefs believed this option was impractical. The means of all groups were less than neutral on the impractical side of the ranking scale.

(9). Stop Live-Fire Training

Discontinuing live-fire training Air Force wide was rejected by all three groups.

(10). Burn/No-Burn Criteria

Adopting meteorological go/no-go criteria to insure

optimum dispersion conditions during training fires was ranked on the practical side of the scale by all groups. The combined group rated this option as practical and nearly seventy-six percent of all responses were neutral or above.

d. Opinion of Current Air Quality Management

Four questions sought opinions about current environmental management aspects of firefighter training with respect to air quality and atmospheric emissions (Tables D.28-D.31, Appendix).

(1). Regulation Effectiveness

Opinions regarding the statement "that current Air Force Regulations were effectively limiting firefighter training facility air emissions" were generally between neutral and disagree on the Likert scale. The overall was to disagree.

(2). Air Quality Management

The concept that firefighter training facility air emissions could be reduced by effective air quality management in lieu of installing air pollution controls was evaluated by 176 respondents. The EPOs agreed with the statement, the BEEs were either neutral or agreed, and the fire chiefs were neutral. There was general consensus between the three groups.

(3). Standardization and Regulation

Each group of professionals was asked if fire training areas should be more standardized and better regulated Air Force wide. Each group favored this option as indicated by placing it on the practical or feasible side of the scale. The EPO responses exhibited more inter-group variance than did the BEE and fire chief responses.

(4). Management Attention

There was a consensus among study participants that more management attention was needed in the use and operation of live-fire training facilities.

e. Pre-burn Coordination and Complaints Received

In addition to specific questions about on-base and off-base coordination procedures, some general knowledge questionnaire items were included to measure each subject's involvement with management related activities regarding live-fire training exercises at their base (Tables D.32-D.36, Appendix).

(1). Waste or New Fuel

Each study group was asked independently whether their base burned waste fuel for firefighter training. The Fire department information, which should have been most accurate since they were the ones who either purchased new fuel or obtained waste fuel, indicated that about half of the bases burn waste or contaminated fuel for fire suppression practice. The EPO and BEE total responses were similar to those of the fire chiefs. However, these responses are for all bases combined, and no assessment was made of for individual bases. The inter-group comparison for correctness was included in Chapter VI.

(2). Restrictions On Fuel

The EPOs and BEEs were asked if they knew whether Air Force Regulation 92-1, Chapter 3, Fire Protection Training, guidelines concerning fuels to be burned during practice fires were used at their base. This regulation prohibits the use of fuels containing more than ten percent by volume of oils or lubricants, fuels containing polychlorinated biphenyls, or solvents and chemicals defined as

hazardous wastes by 40 CFR Part 261. Almost half of the BEEs responded that they did not know if the regulation was followed; whereas, only nine percent of the EPO responses indicated they did not know. The responses of both groups were essentially divided between Yes or Don't Know, with only two stating that the regulatory criteria was not used.

(3). On-Base Notification/Coordination

The extent of fire department coordination with other base agencies was investigated. The fire chiefs were asked to estimate the frequency of coordination with other base agencies prior to conducting live-fire training. The EPOs and BEEs were similarly asked if their offices were notified prior to each practice burn. Fifty-one of fifty-two responding Fire Departments indicated that their training exercises were always coordinated on-base prior to burning. The other department reported they frequently coordinated training fires. However, seventy-seven percent of the BEEs, and sixty-seven percent of the EPOs said their offices were never notified prior to training fires.

(4). Notification of Local Agencies

The fire chiefs and Environmental Protection Officers were asked about pre-burn notification or coordination with local pollution control officials. The EPOs on nearly one-third of the participating bases responded that they believed training fires were never coordinated. Fire chiefs reported that about sixty-four percent of their bases coordinated training burns with local regulatory officials. Seventeen percent of the EPOs did not know if practice fires were coordinated, and about eight percent of the participating fire departments indicated they did not know if pre-burn coordination took place.

(5). Citizen Complaints

Each group of professionals was asked if they had received complaints regarding operation of the firefighter training facility. The fire chiefs reported a slightly higher percentage of complaints about training fires than the other groups. However, relatively few bases (12%) reported having received complaints about their fire training facility operations.

D. Upper Level Management

Brief letters explaining this research were sent to Chiefs of Environmental Planning, Bioenvironmental Engineering, and Fire Protection at seven Major Air Commands (MAJCOMs). The letter asked recipients to score the same management alternatives, opinions of training effectiveness and environmental concerns that base level groups had responded to.

The offices contacted were the next higher level of management that normally would be involved with, or could influence firefighter training facilities, programs, and policies as they relate to environmental or air quality management. Each MAJCOM is responsible for a number of individual bases having the same mission orientation. They have approval authority for military construction programs/projects, monitor compliance with Air Force Regulations, and can issue supplemental guidance via policy letters and command regulations.

Fifteen (71%) of the twenty-one letters sent were answered. Six Command Bioenvironmental Engineers, five Command Environmental Planners, and four Command Fire Protection Division Chiefs responded. These

command personnel averaged over twenty years of experience in their respective specialty.

A limited number of possible upper level management participants were included in the study design. Frequency distributions and central tendency determinations of responses were not as significant or conclusive as those for base level personnel.

1. Environmental Impact Considerations

a. Pollution Potentials

The MAJCOM BEEs were evenly divided on whether air emissions from fire training facilities were significant or not. Three of the four responding EPOs indicated that air emissions from practice fires were in their opinion insignificant. The Chiefs of Fire Protection Divisions were divided; two believed air emissions were significant, one believed they were not. Without exception, unlike the responses from base level managers, the fifteen MAJCOM participants indicated that in their opinion the potential to contaminate soil and eventually groundwater from these facilities is far more significant than the potential for adverse air quality impact. Likewise all MAJCOM respondents were unanimous that there was a significant potential for groundwater contamination during firefighter training facility operations.

b. Reduce Air Emissions From Live-Fire Facilities

The Fire Protection Division Chiefs, among the three groups of MAJCOM planners and managers, generally agreed that the Air Force should take positive steps to reduce air emissions from all firefighter

training facilities. The agreement between command EPOs and BEEs was not as strong.

2. Feasibility of Management Alternatives

a. Build New Facilities

The Command Fire Chiefs and EPOs were either neutral or felt it was impractical to build new smoke abated firefighter training facilities. The BEEs, however, were a little more receptive to this concept.

b. Add Smoke Abatement Systems

The fire chiefs were split on this alternative; two felt this was impractical, and two practical. All of the BEEs were neutral or felt such systems were impractical, while the EPOs also felt this option was not practical with three of five having the option an ordinal score of 1.

c. Use Simulators

All three groups either had no opinion or felt use of simulators to be impractical. Eleven of fifteen respondents rated this option as impractical.

d. Send Firefighters To Regional Centers

The Fire Protection Chiefs unanimously rejected this alternative rating it impractical. The MAJCOM EPOs were either neutral or confirmed the fire chiefs, while the Command BEEs favored this option.

e. Designate Regional Training Centers

BEEs were receptive to the idea of identifying bases within their Command as regional firefighter training centers. The Fire Chiefs

rejected this alternative, but not unanimously. The EPOs' responses were either neutral to impractical. One MAJCOM EPO suggested two bases to serve as regional fire suppression training centers.

f. Stop Live-Fire Training

The Command planners and managers, responding to this management alternative, soundly rejected it. Eleven of the fifteen responses ranked the idea as impractical.

g. Burn/No-Burn Criteria

All MAJCOM groups responded that the meteorological go/no-go management alternative was one of the best offered. Ten of fifteen rated it as practical, the other five respondents rated this option slightly below the practical side of the scale.

3. Opinions of Current Environmental Management

a. Current Regulations Are Effective

The Fire Protection Division Chiefs generally agreed with this conclusion. The EPO responses were divided. Three of the six BEEs disagreed with the statement that current regulations are effectively limiting air emissions from firefighter training facilities.

b. Need More Standardization and Regulation

The statement that firefighter training facility design, use and operation need to be more standardized and better regulated Air Force wide was generally agreed with. Twelve out of fifteen respondents either agreed or strongly agreed.

c. Emissions Reduction Through Air Quality Management

The MAJCOM expressed opinions, ranging from neutral to practical, that fire atmospheric emissions could be reduced by effective air quality management instead of installing air pollution controls.

E. Site Visits and Interviews

Twenty different installations were visited during the course of this investigation. Discussions were held with Fire Department Chiefs and Assistant Chiefs for Training, Bioenvironmental Engineers and Technicians, Environmental Protection Officers, and Civil Engineering Planners and Designers. Smoke abated, as well as untreated training fires, were observed during these visits. Preparatory to each visit, a letter was sent to the primary contact explaining the purpose of the research, giving estimated arrival date and time, and indicating that it would be helpful to have certain reports available, and that a visit to observe a training exercise was desirable.

Site visits, conducted during the initial stages of the research, served to confirm information from the Phase I surveys and to pilot-test the Phase II survey instruments during their development. Visits performed after Phase II survey results had been initially analyzed were directed toward investigating reasons for current practices, seeking explanations for variations observed in survey responses, and developing an understanding of rationales for different opinions, concerns, and evaluation ratings of the suggested management alternatives.

Visits to installations were particularly important in discovering practices and procedures that led to inconsistencies in recording and reporting information pertaining to firefighter training and facility use. For example, some base recording and reporting practices did not differentiate between the number of training fires and number of training sessions. Sessions often cover from 1 to 10 separate training fires. Each separate fire in a training session required recharging the

burn pit with an additional quantity of aviation fuel before re-ignition. Often the reported quantity of fuel burned was limited to the quantity initially put in the pit and neglected the additional quantities added between individual training fires.

The actual model, simulating a crashed aircraft, varied tremendously from base to base. Mockup construction ranged from none through unserviceable dumpsters forming the outline of an aircraft, to very large realistic models of cargo sized aircraft fabricated from 1/4" to 3/8" sheetmetal. One resourceful base had greatly reduced the cost of mockup fabrication by entering into an agreement with a local technical college to provide student welder services in exchange for the use of the fire training facility by the college's fire protection training classes.

Tours of fire department facilities and training areas were extremely beneficial in gaining an understanding of the importance of live-fire training, and gaining an appreciation for the "realism" required in this training environment. Through discussions and surveys it was learned that there is no single aircraft fire crash/rescue factor or characteristic that is most important in creating a realistic live-fire training environment. Almost without exception, fire department personnel stated that "realism" required dense smoke, intense heat, and an aircraft sized fire.

Fire department training scenarios and practices also varied widely from base-to-base. Some bases use only water to train firefighters to extinguish fuel fires, other bases use fire truck turrets to apply an extinguishant to the blaze, while other bases provide trucks only on standby and the crews advancing with handlines extinguish the blaze.

These different practices can affect the quantity of air pollutants that are emitted from training fires by altering the burn duration, fire temperature, and quantity of fuel consumed before the fire is extinguished.

CHAPTER VI

ANALYSIS AND DISCUSSION

Air emission factors and calculation methods currently used to estimate annual atmospheric air pollutant emissions from practice fires are presented in this chapter. Management indices are developed from facility use and firefighter training parameters collected during this research. Responses to identical questionnaire items by the three study subject groups are compared for correctness of response and accuracy. Training fire air pollution potential is discussed in terms of source strengths, plume rise, and dispersion considering current capabilities and uncertainties. Additionally, attitudinal responses to identical environmental concern and evaluation of candidate air quality management alternatives are discussed with respect to possible differences due to geographic location or size of mission aircraft mockup at the base's FFTF.

A. Air Emission Estimates

1. Development of Emission Factors for JP-4 Training Fires

Emission factors are a statistical average of the rate at which pollutants are released to the atmosphere by some generating activity, divided by the rate of the activity. They are developed using a variety of techniques, each of which can give results with different levels of precision. Methods normally used are (in order of decreasing precision): source testing using multiple measurements, testing by

single measurement, process material balance, and engineering analysis of the process. Quality ratings have been developed to describe the confidence level attained with each particular set of emission factors. Based on the technique used to develop the factors and the amount of actual source testing (Stern, et al, Vol III, 1977, pp. 64-75), five emission factor qualitative ratings are used -- excellent, above average, average, below average, and poor.

EPA's Office of Air Quality Planning and Standards maintains, updates, and publishes AP-42, Compilation of Air Pollutant Emission Factors. This document is a compilation of emission factors for most common emission categories: fuel combustion by stationary and mobile sources; combustion of solid wastes; evaporation of fuels, solvents and other volatiles; various industrial processes; and miscellaneous sources. The purpose of the publication is to provide criteria pollutant emission factors for use in preparing emission inventories in instances where site specific source testing data is not available.

The San Diego Air Pollution Control District (SDAPCD) requested that Source Classification Codes (SCCs) for firefighter training be included in AP-42 (Bradley, Personal Communication with California Air Resources Board, April 7, 1986). The document now contains the following Source Classification Codes for firefighter practice fires:

Table 6.1

AP-42 Source Classification Codes for Firefighter Training Fires

Solid Waste Disposal - Government

Open Burning Dump

SCC 5-01-002-03 Jet Fuel

Firefighting

SCC 5-01-006-01	Structural: Jet Fuel
SCC 5-01-006-02	Structural: Distillate Oil
SCC 5-01-006-03	Structural: Kerosene
SCC 5-01-006-04	Structural: Wood Pallets

No emission factors for these SSCs have been developed for inclusion in AP-42. SDAPCD has developed emission factors for the U.S. Navy firefighter training facility in its jurisdiction. These were based on source tests and engineering estimates. However, emission factors for jet fuel fires (5-01-002-03 or -006-01) were not included. There have been reports in the literatuare indicating that SSC 5-03-002-03 (AP-42) for incinerating automobile components, have been used to estimate emissions from firefighter training facilities. These factors could possibly be correctly applied to vehicular fires used to train firefighters in automobile fire suppression and occupant extraction. But, using them to estimate emissions for JP-4 practice fires would be a misapplication of the factors.

AP-42 was the major emission factor source document used by USAF Bioenvironmental Engineers to prepare installation Annual Air Emission Inventories. A variety of civilian and military technical reports and publications were used to supplement this document. However, these documents were not available at all bases.

The USAF Environmental Health Laboratory at McClellan AFB, CA performed a study in 1971 to measure atmospheric emissions and develop emission factors for a JP-4 firefighter training fire. This study involved exhaust duct sampling at a Navy training school in an engine room fire simulator facility equipped with an afterburner emission control system. Pollutant concentrations in the combustion gases were measured and emission factors were calculated on the basis of a carbon material balance. The study concluded that total pollutant emissions were nearly a half pound for every pound of fuel consumed. Particulates and carbon monoxide constituted the predominant mass fractions. The author questioned whether burning JP-4 inside a structure satisfactorily simulated open burning conditions.

From August 1972 through February 1973 the Air Force Weapons Laboratory (AFWL) conducted research to quantitatively evaluate a water spray smoke abatement system for JP-4 practice fires. This study produced an optimal water injection spray nozzle design criteria and emission factors in terms of pounds of pollutants emitted per 1000 pounds of JP-4 burned. The test apparatus was a 14 inch deep, 4 by 4 feet fire pan, filled with 7 inches of gravel and water. Ten gallons of JP-4 was floated on the water surface for each sampling burn. Air samples were collected on an 8 by 8 feet stack/tower, 21 feet high. Six treated (smoke abated) and six untreated (no smoke abatement) fires were burned in the model apparatus for comparison. During these tests the instruments designated to measure CO and total hydrocarbon (THC) concentrations for the untreated JP-4 fires were driven off scale at the lowest sensitivity settings for the instruments; therefore, peak emission concentrations for CO and THC were not obtained. The

investigations concluded that, with the prototype smoke abatement system, there was a definite decrease in CO concentration and a measurable decrease in THC. Additionally, it was observed that for a 10 gallon fire, the burn time increased about two minutes with the water spray system operating. This was interpreted to mean that the smoke abatement system reduced the rate of vaporization of the fuel. There were no measurable amounts of SO_2, SO_3, or benzo(a)pyrene (BAP) in samples from these JP-4 fires. It was not stated if particulates were analyzed for BAP. Material balance calculations were used to develop emission factors for particulates, NO_x, and CO (Haney and Ristau, May 1973).

Table 6.2 contains emission factors from USAF studies of non-abated and smoke abated JP-4 training fires. Additionally, emission factors for firefighter practice fires have been published by AFWL and Argonne National Laboratory as part of the documentation for the Air Force Air Quality Assessment Model (AQAM) (Rote and Wangen, Feb 1975).

In summary, the emission factors that have been used to estimate annual emissions of particulates, CO, and NO_x from JP-4 firefighter practice fires, were developed from material balances following engineering tests. When the individual emission factors were added, the result was 1012 lbs of total pollutants per 1000 lbs of JP-4 burned. This result is in sharp contrast to the earlier EHL study that concluded nearly a half pound of pollutants were emitted per pound of fuel burned. In the case of CO, the true peak concentration was never obtained and the initial test report indicated the emission factor was greater than 560 lbs/1000 lbs JP-4 consumed. More recent, reports which reference

Table 6.2

Emission Factors Used for JP-4 Firefighter Training Fires
(reported as pounds/1000 pounds JP-4 consumed)

Source Document	Particulates	CO	HC	NO_x	SO_x
	Pollutant				
EHL 71M-23, (Suggs, 1971)	195	204	73	3	n/d
AFWL-TR-73-106, (Haney & Ristau, 1973)					
Without Smoke Abatement	128	>560	n/r	4.15	n/d
Smoke Abated Fire	17.6	284	n/r	0.012	n/d
AFWL-TR-74-304, (Rote & Wangen, 1975)					
Air Quality Assessment Model	128	560	320	4.15	0
AP-42, SSC 5-03-002-03*					
Incinerating Auto Body Components	50	62	30	4.00	0

Notes: n/d = none detected

n/r = not reported

* SSC units per 1000 pounds components burned

the earlier study use an emission factor "equal" to 560 lbs. A document, on file in the EPA Office of Air Quality Planning and Standards, containing information provided by the Air Force, listed CO emissions as "less than" 560 lbs/1000 lbs JP-4 burned. No reference was found that discussed the derivation of the current value of 320 lbs of hydrocarbon emissions/1000 lbs of JP-4 burned. This hydrocarbon value first appeared in AFWL-TR-74-304, which documents the AQAM computer program. No more recent attempts to determine or validate the emission

factors since the AFWL December 1975 report were found. Based on the technical literature, it appears that these emission factors may have resulted from calculations based on the results of a single ten gallon JP-4 laboratory test fire conducted during 1972 or 1973. Of the six untreated 10 gallon JP-4 fires reported in the test series, particulates, CO, and NO_x emissions were measured only once.

Thus, the emission factors, presently used to calculate annual air emissions from JP-4 training fires, were derived from limited sampling data and little background information. Basically, the current factors are estimates based on material balance calculations.

2. Inventory Calculation Methodology

Estimates of atmospheric emissions for air emissions inventories are calculated on an annual basis using appropriate process emission factors. Emission factors, pertaining to stationary source processes, represent a composite estimate which includes all subprocesses per unit of material throughput. For example, assume that an incinerating process with a throughput of 100 tons per year releases 5 tons of carbon monoxide to the atmosphere. The emission factor for CO would be 100 pounds per ton of material incinerated.

The general equation used to calculate emissions from firefighter practice burns was: $E_i = N \times (FC) \times (EF)_i$

where: E_i = annual mass emissions of pollutant i

N = annual number of fires, fires/year

FC = fuel consumed in each fire, mass/fire

$(EF)_i$ = training fire emission factor for pollutant i

Generally, one of two slightly different methods were being used by Bioenvironmental Engineers to estimate atmospheric emissions from fire department practice fires. Both of these methods evolved from the same engineering tests and technical reports that document the development of the smoke abatement system for crash/rescue training fires. Both methods use the general equation presented above. The most frequently used methodology for preparing inventories was the School of Aerospace Medicine Handout EH-114, Methods Manual for Calculating Air Pollution Emissions Inventories, 1 Oct 1979, marked for instructional use only. The other method was that of AQAM, which is identical to EH-114, except it neglects evaporative hydrocarbon losses prior to ignition. The AQAM method assumes the entire original quantity of JP-4 is consumed during the training fire.

The emission factors contained in EH-114 are found in the Air Force Weapons Laboratory Technical Report (AFWL-TR) 73-106. However, only emission factors for an untreated (without smoke abatement) open burn of JP-4 are presented as approximations for release of major pollutants. No emission factors from AFWL-TR-73-106 for smoke abated facilities were included in this guidance. The USAFSAM Methods Manual suggests, in sample problem format, that during a typical practice fire burning 800 gallons, 100 gallons are evaporated as hydrocarbon and only 700 gallons are actually burned. Table 6.3 presents the emission factors from TR-73-106 and EH-114. The SO_x emission factor of 0.4 lb/1000 lbs of fuel burned were developed using the mass balance technique and the percent sulfur content in JP-4.

Table 6.3

Comparison of Emission Factors and Estimation Methods For Firefighter Training Fires Without Smoke Abatement

	AFWL TR-74-304 (AQAM)	USAFSAM EH-114 (Handout)
Pollutant	(lb pollutant/1000 lbs burned)	
Particulates	128	128
Nitrogen oxides	4.15	4.15
Carbon Monoxide	560	560
Hydrocarbons	320	320*
Sulfur oxides	0	0.4
Density of JP-4, lb/gal	6.4	6.7

*Total hydrocarbon emissions from practice fires were calculated by summing 1/8th of the original quantity of JP-4 to be burned, with the hydrocarbons emitted from the remaining fuel.

a. School of Aerospace Medicine Handout EH-114

The method presented in EH-114 assumes that 1/8th (0.125) of the initial fuel pool evaporates as unburned hydrocarbons prior to ignition of the practice fire.

(1). Hydrocarbon Emission Estimate:

$$E_{HC\ total} = HC_{evap} + HC_{burn}$$

$$HC_{evap} = 0.125 \times Q_{gal} \times (\text{density JP-4})$$

$$= 0.125 \times Q_{gal} \times (6.7\ \text{lb/gal})$$

$$= 0.8375 \times Q_{gal}$$

$$HC_{burn} = 0.875 \times Q_{gal} \times (\text{density JP-4}) \times (EF_{HC})$$
$$= 0.875 \times Q_{gal} \times (6.7\ \text{lb/gal}) \times (0.320\ \text{lb/lb JP-4})$$
$$= 1.876 \times Q_{gal}$$
$$E_{HC\ total} = (0.8375 + 1.876) \times Q_{gal}$$
$$= 2.7135 \times Q_{gal}$$

(2). Other Major Pollutant Emission Estimates:

$$E_i = 0.875 \times Q_{gal} \times (6.7\ \text{lb/gal JP-4}) \times (EF_i)$$
$$E_{(CO,PM,NOx,SOx)} = 5.8625 \times Q_{gal} \times (EF_{CO} + EF_{PM} + EF_{NOx} + EF_{SOx})$$
$$= 5.8625 \times Q_{gal} \times (.560 + .128 + .00415 + .0004)$$
$$= 4.0601 \times Q_{gal}$$

(3). Total Emissions Estimate:

$$E_{total} = (2.7135 + 4.0601) \times Q_{gal}$$
$$= 6.7736 \times Q_{gal},\ \text{in lb/yr}$$
$$= 3.3868\text{E-}03 \times Q_{gal},\ \text{in ton/yr}$$

b. Air Force Air Quality Assessment Model (AQAM)

Calculating a total emissions estimate by methods and emission factors contained in AQAM is the same as for EH-114 except initial fuel lost through evaporation is neglected and the fuel density used is 6.4 lb/gal.

(1). Hydrocarbon Emission Estimate:

$$E_{HC} = Q_{gal} \times (6.4\ \text{lb/gal}) \times (EF_{HC})$$
$$E_{HC} = Q_{gal} \times (6.4\ \text{lb/gal}) \times (.320)$$
$$= 2.048 \times Q_{gal}$$

(2). Total Major Pollutant Emission Estimates:

$$E_{(CO,HC,PM,NOx,SOx)} = 6.4 \times Q_{gal} \times (.56 + .32 + .128 + .00415 + 0)$$

$$E_{total} = 6.4 \times Q_{gal} \times 1.0122$$

$$= 6.4778 \times Q_{gal}, \text{ in lb/yr}$$

$$= 3.2388\text{-}03 \times Q_{gal}, \text{ in ton/yr}$$

c. Comparison of Methods

The percent difference between the two pollutant emission estimation methodologies is:

(1). Hydrocarbon emission estimate difference:

By EH114: $E_{(HC\ evap\ \&\ burn)} = 2.7135 \times Q_{gal}$

By AQAM: $E_{(HC\ burn\ only)} = 2.048 \times Q_{gal}$

$$\%\ \text{difference} = \frac{2.7135 - 2.048}{2.7135} \times 100\% = 24.5\%$$

(2). Total emissions estimate difference:

By EH-114: $E_{total} = 3.3868E\text{-}03 \times Q_{gal}$, in ton/yr

By AQAM: $E_{total} = 3.2388E\text{-}03 \times Q_{gal}$, in ton/yr

$$\%\ \text{difference} = \frac{3.3868 - 3.2388}{3.3868} \times 100\% = 4.37\%$$

The only difference between the AQAM and USAFSAM methods for calculating practice fire atmospheric emissions is in the estimation of total hydrocarbons. The EH-114 method assumes 1/8th of the initial fuel pool evaporates as hydrocarbon. The AQAM method estimates 24 percent less hydrocarbon emissions. There is not a significant difference (4.37%) in estimated total pollutant emissions between the two methods.

The density of JP-4 fuel is also different for the two methods: 6.4 lbs/gal in AQAM, and 6.7 lbs/gal in EH-114. This accounts for 4.48% of the difference in the calculated values.

B. Management Indices

1. Facility Use

Two parameters were used to evaluate firefighter training facility utilization: 1) the number of training fires conducted annually, and 2) the quantity of fuel burned in each training fire. These parameters determine the amount of air pollutant generated at each installation as the result of conducting firefighter training practice fires. Additionally, consideration of both factors was necessary to properly measure the overall facility use. One installation could be conducting many training fires using relatively small quantities of fuel; whereas, another base could be burning few practice fires consuming large quantities of fuel. The total quantity of air pollutants emitted from two such hypothetical bases annually could have been the same. From an air quality management standpoint, the two factors should be analyzed independently as process frequency and material throughput.

a. Training Fires Per Year

Air Force regulations specify the frequency with which firefighters must take part in live-fire training exercises to maintain proficiency and meet career progression requirements. Military and DOD civilian apprentice level firefighters must receive aircraft crash/rescue live-fire training quarterly, more experienced fire prevention personnel must be trained semi-annually (AFR 92-1(C1), 1983).

Discussions with personnel during site visits disclosed that the typical fire department had a maximum of 10% apprentice firefighters assigned at any given time. The apprentice upgrade period usually required one year of on-the-job training.

The Phase I Fire Department survey revealed that the average fire department personnel strength was: 43 military and 31 civilian firefighters, an average assigned strength of 74 firefighters. In the typical department 86%, or 64 of 74 firefighters received live-fire training at some required frequency. Assuming 10% of the 74, or seven firefighters were apprentices and had to be trained in live-fire aircraft crash/rescue procedures every three months, the remainder, or 57 firefighters would require training twice per year. This yielded an average minimum of 142 ((4 x 7) + (2 x 57)) live-fire training experiences required per year at every base. The surveyed fire departments reported that, on the average, each firefighter is live-fire trained almost six times per year. This indicated that each base averaged 384 (6 x 64) live-fire experiences annually.

Responses to surveys indicated that from 4 to 116 firefighters are credited for being trained per practice fire. In discussions with fire department personnel during site visits, it was disclosed that some departments count all firefighters on duty or assigned during a training fire as having been "trained". In reality, the entire shift had not participated in extinguishing the practice fire, but many had been prebriefed, had observed the training exercise, and/or had attended the post exercise critique or outbrief. It could not be determined if this method of counting was intended by the training regulation.

The number of base firefighters actively involved in a single aircraft crash/rescue training fire varied from 16 to 24 persons. This includes those firefighters advancing on the mockup with handlines actively engaged in extinguishing the fire, those driving the fire trucks and/or operating turrets, and those participating in backup and safety observational capacities.

Assuming that 16-24 firefighters are actually trained per training fire, and using 20 as a reasonable average, 7.1 or 8 training fires per year would be needed to satisfy the minimum requirements of 142 annual live-fire training experiences for the average 74 person fire department. Using the fire department estimate of an average of 384 training experiences per year per base, 19.2 or 20 training fires per year, involving 20 firefighters, would be required.

b. Gallons of Fuel Burned Per Fire

Air Force Regulation 92-1 specifies the quantity of fuel to be burned in practice fires based upon size of the training facility burn area. It states that 300-500 gallons of fuel is adequate for a 3000 ft^2 burn surface (60 feet diameter), and 600-900 gallons for a 7000 ft^2 burn area (95 feet diameter). The 95 and 60 feet diameter burn surfaces are representative of the relative size of aircraft simulated in the fire. The mockup used at each base is supposed to be an accurate representation of the largest aircraft serviced or operated at that installation.

The average amount of JP-4 fuel burned per training fire was 570 gallons Category A bases which simulate aircraft crash/rescue for larger mission aircraft. The average for Category B installations, smaller

mission aircraft, was about 430 gallons. These amounts are within the limits established by regulation. However, the maximum reported by individual Category A and B bases were 2000 gallons and 1500 gallons respectively.

Discussions with fire department personnel during site visits, indicated that the exact quantity of fuel used per training fire is not accurately monitored, recorded, or reported at all bases. Another source of uncertainty is trying to estimate the actual portion of the fuel pool consumed in the fire prior to extinguishment. The air emission inventory procedures employed in this study assumes that all fuel placed in the training area evaporates or is consumed in the fire. This was not the case at all training areas visited. Many of the facilities still had standing water with a floating fuel film on the surface which was left over from the most recent training fire. It was not possible to estimate the actual quantity of fuel left unburned following a practice exercise. Fire department personnel estimate that from 10 to 80% of the original fuel pool is combusted in a typical training exercise depending on the proficiency of the firefighters.

Another source of uncertainty in estimating air emissions involves the operational procedures used during training fires. A training session usually involved lighting more than one training fire. A single training session used multiple training fires or a series of re-ignitions of the original fuel pool. During a site visit it was observed that even though a department reported burning only 250-300 gallons per training fire, this was actually the amount used in the initial fire. The fire pit was then recharged as many as four times with 200-400 gallons of additional fuel depending on the training

scenario established by the responsible on-scene training supervisor conducting the training. Fire departments using foam extinguishing agents during practice fires had to empty the burn basin or remove the residual foam/fuel mixture before recharging the pit since this agent effectively prevented further combustion of the fuel. Fire departments using only water to extinguish practice JP-4 fires, were able to use the residual unburned fuel in the next burn in the series. However, fighting jet fuel fires with water was not a widely accepted fire suppression practice and was felt by many to be unsafe and does not provide a realistic training experience.

Therefore, it was assumed that the quantities of fuel reported in the survey were minimum values, while actual quantities, even though they could not be determined, were much higher.

The facility design criteria does not specify the quantity of fuel to be put in the pit. The quantity of fuel to be used is a local decision and is not considered to be a facility specifications. From discussions with fire department personnel, 250 gallons of JP-4 was regarded as an acceptable quantity needed to create a realistic single excursion live-fire aircraft crash/rescue training environment.

c. Facility Use Index

A facility use index (FUI) was derived to compare differences between bases, mockup classes, study categories, and geographic regions. The FUI is an estimate of the total annual air pollutant emissions from an individual live-fire training facility expressed as tons of air pollutant released per year (tons/yr). FUIs were calculated by:

$$\text{FUI (tons/yr)} = \text{\# of Training fires per year} \times \text{Quantity of JP-4 burned per fire} \times \text{Total of All Emission Factors}$$

$$= [\text{fires/year}] \times [\text{gallons/fire}] \times [3.39\text{E-03}]$$

$$= \text{tons of air pollution emitted annually from training fires}$$

The FUI for each base was computed using Air Force emission factors for JP-4 fires, number of training fires conducted per year, and quantity of fuel burned per fire as reported on the Phase I Fire Department survey instrument. The overall average FUI for all bases that responded was 40 tons/yr. Category A bases averaged 48 tons/yr, and Category B 31 tons/yr. Using the number of fires per year needed to satisfy training requirements (minimum of 8 and maximum of 20 fires/year) and the quantity of fuel burned at Category A and B bases (570 and 430 gallons/fire), the theoretical FUI for Category A bases was 15.5 to 38.6 tons/yr, and for Category B bases 11.7 to 28.8 tons/yr.

In summary, theoretical estimates of total annual air pollutant emission calculated from training requirements were less than the FUIs calculated directly from facility use data. This suggests that more fuel was being used than was actually needed to satisfy even the maximum reported training requirements.

2. Firefighter Training

In addition to the FUI, two Firefighter Training Indices (FTIs) were devised to measure training efficiency in terms of the number of firefighters trained per practice fire and the amount of fuel burned per firefighter trained. Data used to calculate these indices were obtained from the original surveys. This information included: the number of military and DOD civilian firefighters assigned, the number of assigned

firefighters trained annually, and the number of live-fire training experiences each firefighter received per year.

a. Number of Firefighters Trained

The average number of firefighters participating in career progression or periodic refresher aircraft crash/rescue training at the base level was 64 in the average department or about 86% of the assigned strength of 74 at a typical installation. Mockup Category A fire departments averaged 75.1 firefighters with 66.2 (88%) receiving annual live-fire training. Category B fire departments averaged 72.6 firefighters with 62.7 (86%) being trained yearly. These averages were similar on a regional basis: geographic regions I-IV, 85%; regions V-VII, 85%; and regions VIII-X, 91%, annually.

b. Number of Times Trained Annually

Fire departments reported the number of times per year each firefighter received live-fire training. AFR 92-1 establishes the minimum acceptable quarterly training frequencies for apprentice firefighters, and semiannually for more experienced personnel. Thus, the average number of required annual training experiences could vary from base to base depending on the training level of firefighters assigned. Survey data indicated firefighter training frequencies for each firefighter ranging from 2 to 28 times per year. The arithmetic mean for all bases was 5.6 with a standard deviation of 4.4. This suggests that fire chiefs typically exceed minimum training frequency requirements. Category A base firefighters averaged 4.8 annual training experiences, or over twice the required minimum training frequency, and Category B bases 7.0 live-fire practices per firefighter trained, which

was more than three times the required minimum number. This difference could not be explained by the size of the training aircraft mockup which is representative of the mission aircraft assigned to a base. Geographically, there was also a difference in the number of times each firefighter received live-fire training, and again no apparent reason could be established.

c. <u>Firefighter Training Index (1)</u>

An index for firefighter training was devised to measure training efficiency in terms of the number of firefighters trained per practice fire. The general equation used to calculate the theoretical number for each base providing data was:

$$\mathrm{FTI}(1) = \frac{(\text{No. Firefighters Trained/yr}) \times (\text{No. Times Trained/yr})}{(\text{No. Training Fires/yr})}$$

FTI(1) values were calculated using data provided by participating fire departments. Standard deviations were quite large for this index (FUI (1)). Two factors may have accounted for this large variance and apparent uncertainty. The number of training fires conducted per year, as reported in the survey, may have been an accurate reflection of the number of training "sessions" per year rather than the actual number of training "fires" burned for firefighter training. It was found that usually each training session included more than one practice fire. Secondly, the practice of counting and reporting the number of firefighters "on duty" at the time of a training session could have increased the calculated number of times per year each firefighter was trained.

The original survey instrument requested the number of firefighters trained per fire. The values reported by base fire departments ranged from 3 to 65 with an arithmetic mean of 14.7.

d. Firefighter Training Index (2)

A second index was used to compare training efficiency in terms of gallons of fuel burned per firefighter trained. FTI(2) was a function of FTI(1) and a facility use parameter. The general equation was of the form:

$$FTI(2) = \frac{\text{Gallons of Fuel Burned/Fire}}{\text{No. Firefighters Trained/Fire}} = \frac{\text{gal/fire}}{FTI(1)} = \frac{\text{gal JP-4 burned}}{\text{person trained}}$$

FTI(2) contains the same uncertainties as FTI(1). The calculated values of FTI(2) ranged from 4 to 339 with an arithmetic mean of 46.6 gallons of JP-4 burned per firefighter trained. Tables D.37 and D.38 (Appendix) present summaries of the fire department interval data used to calculate Firefighter Training Indices.

These firefighter training indices can be used as management tools to optimize training efficiency at base level. FTI(1) could be used to calculate the actual number of training fires per year needed to satisfy installation training requirements by optimizing the number of individuals trained per practice fire. FTI(2) could be used to measure training efficiency in terms of the quantity of fuel burned per practice fire with respect to the number of persons trained per fire. Additionally, they could be employed to measure management efficiency of firefighter training programs if standard recording and reporting procedures were adopted.

For example, scheduling 20 firefighters per fire, taking part in 3 training exercises per year, and burning 300 gallons of fuel per fire, would yield the following indices for a hypothetical fire department of 74 firefighters:

$$\text{FTI(1)} = \begin{matrix}\text{20 firefighters} \\ \text{trained per fire}\end{matrix} = \frac{\text{(74 firefighters)} \times \text{(trained 3 times/yr)}}{\text{(No. of fires/yr)}}$$

Solving FTI(1) for the required number of practice fires per year,
No. of fires/yr = (74) x (3) / (20) = 11.1 or 12 fires/yr

And calculating the amount of fuel burned per person trained,

$$\text{FTI(2)} = \frac{\text{300 gallons JP-4/fire}}{\text{20 firefighters trained/fire}} = \text{15 gal JP-4 / person trained}$$

C. <u>Correctness/Accuracy of Responses</u>

State implementation plans and state air pollution control regulations were used to evaluate the accuracy of selected questionnaire responses. The evaluation of facility use was based on three independent data sources. Intra-base communication and coordination were evaluated by comparing independent responses to identical questionnaire items by the three professional groups surveyed.

1. <u>Regulatory Agency Factors</u>

a. <u>EPA Nonattainment Areas</u>

EPA publication <u>Maps Depicting Nonattainment Areas</u> (US EPA 450/2-85-006, Sep 85), issued in September 1985, by the Office of Air Quality Planning and Standards, was the basis for determining whether

each base in the study was located in an EPA designated Clean Air Act Nonattainment Area.

Of the 85 bases included in the study, 38 were located in Clean Air Act Nonattainment Areas. Table 6.4 lists the NAAQS pollutants and the corresponding number of bases in nonattainment areas for those pollutants.

Table 6.4

USAF Bases Located in Clean Air Act Nonattainment Areas

	TSP	CO	NO_x	SO_x	Ozone
No. of bases located in areas exceeding NAAQS for pollutants shown	22	22	3	2	28

Bioenvironmental Engineers were asked if they knew whether their base was in a designated Nonattainment Area. Sixty (60) BEEs responded. Thirteen (13) believed they were in nonattainment areas, 31 indicated they were not, and 16 stated they did not know if they were or not. BEE responses were compared base-by-base with EPA county maps depicting nonattainment areas, 31 (52%) were correct, but 8 of these 31 identified the wrong pollutant(s) exceeding NAAQS which was the basis for non-attainment; 26 responses were incorrect with respect to being located in a designated area, 24 of the 26 incorrectly stated they were not in a nonattainment area, and 2 stated they were when they were not. Of the 16 BEEs who responded that they did not know, 6 were in nonattainment areas and 10 were in areas not exceeding NAAQS. Of the 25 base BEEs who did not return surveys, 13 of those bases were located in Clean Air Act Nonattainment Areas for one or more criteria pollutants.

b. State Implementation Plans

Thirty-seven SIPs, from states with at least one Air Force base within their boundaries, were identified and reviewed to determine if any regulatory requirements pertained to firefighter training activities. All of the SIPs contained direct references to open burning for the purpose of training firefighters. Some SIPs and related state air pollution rules/standards allowed essentially unregulated live-fire firefighter training while others required specific permitting, waivers, restrictions, and prior notification.

The Bioenvironmental Engineers were asked if their state implementation plan addressed open burning for the purpose of training firefighters, and if a permit or waiver was required for operation of their live-fire facility. Eighteen (18) BEEs correctly knew that this activity was discussed in the respective SIP, 10 incorrectly indicated it was not, and 25 did not know. Seventeen (17) BEEs out of the 60 (28.3%) returning surveys believed they knew the regulatory requirements of the state in which their base was located. Twelve correctly identified exemption, permitting, or waiver requirements for conducting firefighter training contained in their state's laws. Five incorrectly believed they were in locations where firefighter training was exempted from control by state air pollution standards or rules.

SIPs were used to identify 18 bases in states that require firefighter training facility permits. Of the 18 bases, 4 of the BEEs indicated they knew of the permit requirement. Additionally, most SIPs or state air quality standards/rules require some form of written approval or authorization, and often have specific conditions or restrictions pertaining to firefighter practice fires. It was apparent

that most BEEs were not aware of specific state requirements pertaining to open burning for purposes of training firefighters.

2. <u>Analysis of Independently Gathered Facility Use Data</u>

Three independent data sets were used to evaluate the consistency and accuracy of recording and reporting firefighter training facility use information. Facility use was obtained from fire departments in every case, but was gathered by three different groups during separate programs or projects. All fire departments were contacted to provide facility use information (fires/year and gallons/fire). Three data sources were tabulated and used as the basis for comparing reporting practices and assessing the accuracy of information provided.

a. <u>Phase I Fire Department Survey</u>

Facility use information, including average quantity of fuel burned per fire and number of fires per year by month for the previous two year period, current year, and a future year estimate was requested in the original survey. The typical Air Force installation that took part in this study conducted about 26 practice fires per year, burned 502 gallons of JP-4 in each fire, and produced about 40 tons of air pollution from firefighter training.

b. <u>Bioenvironmental Engineering Air Emissions Inventories (AEIs)</u>

The BEE questionnaires included a specific request for each installation's most recent annual air emission inventory. These responses were used as an independent source of firefighter training facility use data. Almost half of the returned AEIs contained only tons/year information and did not include fires/year and gallons/fire in the final inventory document. The overall averages from AEIs were: 27

fires/year, 390 gallons/fire, and 58 tons of air pollutants/year for the typical base.

c. DOD Installation Restoration Program (IRP) Reports

DOD IRP Records Search Reports were also used as an independent source of live-fire training facility use information. Most of the reports obtained identified fires/year and gallons burned in a practice fire. Since the IRP was initiated in 1980, some training facility use information could have changed since the IRP survey. Forty-three IRP reports were obtained through NTIS. The means from these reports were; 19 training fires/year, burning 534 gallons of fuel, and producing 33 tons air pollutants per year per installation.

d. Summary

Table 6.5 shows facility use information tabulated by data source. Facility use values from all available data sets were used to calculate the FUIs in this table. The mean values were based on different sample sizes, and were not presented as an intra-base comparison of reported facility use data. This information does illustrate the large variation in facility use information that was published or releasable to pollution regulatory agency officials regarding open burning for firefighter training.

Table 6.5

Firefighter Training Facility Use Parameters & Index from Independent Sources

Data Source	Parameter*	Sample Size	Min	Max	Mean	Stnd Dev
FD	Fires/Year	72	4	134	25.8	19.2
BEE		27	4	120	27.0	27.5
IRP		46	4	72	19.4	14.8
FD	Gallons/Fire	72	100	2000	502.2	343.2
BEE		27	50	1000	390.4	249.8
IRP		43	125	2500	534.3	499.2
FD	FUI, tons/yr	70	4.1	271.1	40.0	37.7
BEE		46	2.0	806.2	58.2	129.3
IRP		43	3.4	121.9	33.1	30.1

*per base

Table D.39 (Appendix) presents the results of an intra-base comparison of 25 installations for which all three sources of data were available. Fire department survey data was considered the most accurate and up-to-date, and was used as the "correct" facility use information for intra-base comparisons. The FUIs for FD and IRP data were calculated using the USAFSAM Handout EH-114 method, and the AEI annual emissions value was taken from each base's inventory provided by BEEs in their responses to questionnaires.

This analysis showed that only one installation's facility use data was the same for the Fire Department survey, the BEEs AEI, and the DOD IRP Records Search Report. The reported values in the three data sets exhibited considerable disagreement. FUIs from 5 of 25 BEE inventories over estimated annual emissions by at least a factor of two compared to the FUI calulated from FD data. Eight BEE AEIs under

estimated annual emissions from firefighter practice fires by at least a factor of two lower than those calculated using FD submitted values. IRP data used to calculate FUIs yielded 6 values that were at least two times greater than FUIs calculated from FD data. Similarly, 8 IRP FUIs underestimated, by at least a factor of two, compared to the corresponding FD FUI calculated by the same method.

There was a similar lack of agreement between the AEIs and the IRP Reports facility use data. Six calculated IRP FUIs overestimated the same annual emissions by at least a factor of two compared to the AEI for specific installations. Additionally, of the 25 sets of paired facility use data, 5 FUIs calculated from IRP information underestimated the corresponding base's value, as calculated by the BEE, by at least a factor of two.

3. Use of Waste Fuel for Practice Fires

All three groups of professionals were asked whether waste or new JP-4 was burned for firefighter training at their bases. Since fire departments requisition fuel for training, they should know whether new or waste jet fuel was used. The information submitted by each fire department was considered correct for this analysis.

Forty bases responded to the question regarding type of fuel burned in practice fires. This provided 40 sets of paired responses from the three professional groups. At fifteen bases (37.5%), the fire department, BEE, and EPO all agreed or knew what type of fuel was burned during training exercises. Nine bases burned waste fuel, but the BEE, EPO, or both did not know or believed only new JP-4 was being used for firefighter practice fires. Similarly, sixteen bases reported burning

only new JP-4; however, the BEE, EPO, or both did not know or believed the fire department was using waste fuel.

D. Air Pollution Potential

A 300 gallon JP-4 practice fire releases approximately 1 ton of air pollutants when calculated by current USAFSAM methodology. The potential for adverse air quality due to firefighter training activity is a function of source strength or emission rate, plume rise, and meteorological influences. Training fires are considered point sources with a plume rise due entirely to thermal bouyancy and emissions are calculated on an annual basis, not as an episodal or single occurrence. When air emissions from these facilities are averaged over 8760 hours in a year, emission rates are very low. However, if viewed as a single episode, with up to 4 training fires during a 1 to 2 hour training session, short-term local adverse air quality impacts are possible.

1. Source Strength

Firefighter practice fire source strength values, or mass of air pollutants released per unit time, are a function of the quantity of fuel burned and the duration of the fire. These values are estimated using current USAF emission factors, various quantities of fuel, and an estimation of practice fire duration. No information was found that documented the actual quantity of fuel burned per unit time during training fires.

The quantity of fuel actually consumed in a practice fire has not been determined. As previously noted, current emission factors were calculated by mass balance techniques using data derived from a laboratory study which burned 10 gallons of JP-4 to completion with no

suppression or extinguishment. From direct observations and discussions with fire protection personnel, there is not a consensus regarding the percentage of the original fuel pool that remains unburned after extinguishing of a training fire. Expertise and efficiency of the firefighter team, and the extinguishing effects of the suppressant agent on the burning fuel fire affect the quantity of fuel consumed. The time to extinguish a fire is a function of suppression method. Some base fire departments used only an advancing team of firefighters with handlines to extinguish the fire, other departments employed firetrucks with water/foam spray turrets which require much less time. Firefighting foam also had an effect on extinguishment time. Bases extinguishing practice fires with only water would experience longer burn times than bases where suppressant foam was used to put out jet fuel fires.

The release of combustion products occurs for the duration of the training fire. Information provided by fire department personnel indicated that training sessions typically last for one to two hours. During that time, depending on extinguishing agent used, one to four practice fires are usually burned. Bases that use only water to fight JP-4 fuel fires, could re-ignite the same fuel pool for additional training. When firefighting foam was used, the residual fuel-foam mixture does not burn and the burn area was recharged with an additional quantity of fuel between practice fires.

For this investigation, the assumption was made that the entire fuel pool was consumed during a training session lasting one hour consistent with current USAF inventory methodology. This assumption permitted an estimation of source strength that was independent of the

number of re-ignitions of the fuel pool and was based solely on the quantity of fuel added to the fire training area during a practice session. Table 6.6 lists estimated total and specific pollutants released and source strengths for various sizes of JP-4 firefighter practice fires.

Table 6.6

Air Pollution Emissions and Source Strengths
JP-4 Firefighter Training Fires

Qty JP-4 burned, gallons	Pollutants Released				Source Strength,* gm/sec		
	CO, lbs	HC, lbs	PM, lbs	Total,** tons	CO	HC	PM
250	938	536	257	0.85	118	68	27
500	1876	1072	429	1.70	237	135	54
750	2814	1608	643	2.54	355	203	81
1000	3752	2144	858	3.39	473	270	108
1250	4690	2680	1072	4.24	568	338	135
1500	5628	3216	1286	5.08	710	406	162

* one-hour training session duration assumed
** includes CO, HC, PM, NO_x, and SO_x

2. Atmospheric Assimilative Capacity

The assimilative capacity of the atmosphere is a function of turbulence and available quantity of air for dilution of the emissions. Generally, the plume from a point source would spread in the horizontal and vertical dimensions as determined by the degree of turbulence or atmospheric stability. The available dilution air volume is limited in the vertical dimension by the height of the convective or mixing layer. Typically, both atmospheric stability and mixing height magnitudes vary with the time of day.

Atmospheric stability categories can be determined by a scheme developed by Pasquill and modified by Turner (Hanna, Briggs, Hosker, 1982, p. 27). Tables 6.7 and 6.8 illustrate six stability categories (A through F) which are based on five classes of surface wind speeds, three classes of solar insolation (daytime), and two classes of nighttime cloudiness.

Table 6.7

Atmospheric Stability Categories

Pasquill Stability Category	Stability Description
A	Very unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable

Table 6.8

Atmospheric Stability Classification Scheme

Surface Windspeed (at 10m), m/sec	Daytime Conditions Incoming Solar Radiation			Nighttime Conditions*	
	Strong	Moderate	Slight	Thinly overcast > 4/8 cloud	Clear < 3/8 cloud
<2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

*Assume class D for nighttime overcast conditions.

Generally, in the early morning hours the atmosphere is stable with a radiation inversion extending from the surface to the height of the mixing layer. There is little vertical mixing and a plume expands horizontally rather than vertically. Fanning plumes often result under stability categories E or F.

Later, the air near the surface warms and becomes unstable, but the radiation inversion has not yet lifted. This results in stable air above and unstable air below. Pollutant concentration near the surface increases, because vertical mixing occurs only in the trapped layer. This is called fumigation. Stability categories associated with this condition are E or F above the inversion layer, and A, B, C or D below. Another type of fumigation can occur when plume rise is limited by a persistent inversion. These inversions can last several days. This trapping type of fumigation occurs with calm or nearly calm winds, and can lead to persistent high ground-level concentrations.

As heating continues throughout the day the atmosphere may become unstable causing a looping plume pattern as the air moves up and down. This is usually associated with stability categories A, B, or C.

Continued rising of warm air and sinking of cool air can result in a neutral atmospheric condition (D) and a plume can take on a cone shape with vertical and horizontal growth being about equal.

After sundown, the ground cools and the radiation inversion reoccurs. There can be stable air near the ground (E or F) and a layer neutral or slightly unstable (C or D) air above. The stable air prevents the plume from mixing downward, and it is carried upward in a

lofting fashion, (Schulze, Richard H., Trinity Consultants, Inc., Dallas, Texas, Notes on Dispersion Modeling, 10 May 1984, pp. 31-35).

3. Plume Rise

Rise of the plume or column of smoke from firefighter training fires is due almost entirely to thermal buoyancy (Rote and Wangen, 1975, p. 67). No plume rise momentum contribution is considered, because there is no process stack. Buoyant plume rise for training fires has been estimated using the Carson-Moses plume rise empirical formulation (Moses and Carson, July 1968, pp. 454-57).

Carson-Moses formula:

$$H = \frac{A\ (5.35)\ Q_h^{0.5}}{u}$$

where: H = plume rise, m
A = 2.65 for Stability Classes A, B, C (unstable)
1.08 for Stability Class D (neutral)
0.68 for Stability Classes E-F (stable)
Q_h = heat emission rate, kcal/sec
= 2.54E+04 kcal/sec (ref:ibid)
u = windspeed, m/sec

Effective stack height from an industrial process stack is the sum of stack height plus plume rise. In the case of practice fires burned at ground level, effective stack height and plume rise would be the same. Table 6.9 depicts Carson-Moses calculated plume rise for various atmospheric stability conditions and wind speeds.

Table 6.9

Training Fire Plume Rise

Stability Condition	Windspeed, m/sec	Plume Rise, meters
Unstable	2	1130
	4	565
	6	377
	8	282
Neutral	2	460
	4	230
	6	154
	8	115
Stable	2	290
	4	145
	6	97
	8	72

These values indicate that even under stable atmospheric conditions there is a large buoyant plume rise component equivalent to an effective stack height of over 70 meters. In a neutral or unstable atmosphere, a buoyant plume would theoretically rise indefinitely and eventually lose its identity due to diffusion. Under stable atmospheric conditions, the buoyant plume would reach equilibrium with the surrounding atmosphere and lose its buoyancy (Stern et al, Vol. III, 1977, pp. 420-436).

4. Training Fire Atmospheric Dispersion Models

Two computer programs are available that specifically include firefighter training fire emission and dispersion forecasting capabilities: USAF Air Quality Assessment Model (AQAM), and FAA's Graphical Input Micrcomputer Model (GIMM) (Segal, 1983).

a. AQAM

The Air Force model is a sophisticated complex main-frame

computer program. AQAM has both long-term and short-term dispersion simulation models; however, none of the seven AQAM reports obtained included dispersion estimates of training fire emissions. Operationally, AQAM has been used primarily as a computer tool for the preparation of detailed annual air emissions inventories. Generally, firefighter training atmospheric emissions averaged on an annual basis would not be significant compared to all other installation sources. In some published AQAM emission inventories; however, practice fires have accounted for a significant percentage of the total annual fixed facility emissions depending on the fuel source for heat and power production at a particular base.

b. GIMM

The GIMM designed to be run on an Apple IIe microcomputer and Graphics Tablet, has incorporated many of the AQAM features and capabilities. The air emissions inventory portion of the program includes a firefighter training fire category under the fixed facilities segment. GIMM provides annual emission estimates equal to AQAM values. Sigma x,y,z default values for training fires in the GIMM dispersion model are different than those programmed into AQAM. Additionally, Carson-Moses plume rise for training fires is not computed directly, but can be entered as a default override.

c. Discussion

Calculation of meaningful groundlevel concentrations were not within current capabilities because of the uncertainties in estimating source strengths, variation in and shortness of burn durations, and large effective stack heights.

However, to demonstrate the theoretical significance of meteorological considerations on groundlevel concentration estimates, the Gaussian dispersion equation can be simplified and analyzed. The following assumptions apply to this discussion: 1) release is continuous or of a duration equal to or greater than the downwind travel time from source to receptor, 2) only groundlevel centerline concentrations are of interest (z=0, y=0), 3) plume rise and mixing height are neglected. The Gaussian dispersion equation is thus simplified (Turner, 1970, p. 6) to become:

$$\chi_{(x,0,0,0)} = \frac{Q}{\pi \sigma_y \sigma_z u}$$

where $\chi_{(x,0,0,0)}$ = downwind centerline concentration, mass/volume
= downwind distance, length
Q = emission rate of pollutants, (source strength), mass/time
σ_y = standard deviation in crosswind direction, length
σ_z = standard deviation in vertical direction, length
u = windspeed, length/time

σ_y and σ_z are functions of atmospheric stability, wind speed, surface roughness, distance from the source, and sampling time. Increases in σ_y and σ_z, or u will decrease the downwind centerline concentrations. Table 6.10 illustrates the magnitude of pollutant concentration reduction as a function of the atmospheric stability category. Approximation equations developed by Briggs were used to calculate σ_y and σ_z values (Hanna, Briggs, Hosker, p. 30). The values in the σ_y, σ_z, and u columns would be in the denominator of the centerline concentration equation. Thus, the potential population exposure concentration would be inversely proportional to the σ_y, σ_z, and u values.

Table 6.10 shows that unstable atmospheric conditions would yield the lowest ground level downwind centerline concentrations since the atmospheric assimilative capacities are greatest during these periods. If training fires were only conducted during periods of unstable atmospheric conditions (classes A, B, C), the downwind concentrations would be significantly less than during periods of atmospheric stability (Classes E and F). Surface wind speed usually associated with each stability category somewhat offsets the influence of σ_y and σ_z, since higher σ values are usually associated with lower windspeeds.

Table 6.10

Influence of σ_y and σ_z On Pollutant Dispersion Concentration

Atmospheric Stability Category	Estimation Equations for: (x=croswind distance in m) σ_y	σ_z	σ_y, σ_z in meters at 1km dwnwnd		Windspeed, u in m/sec	$\sigma_y \sigma_z u$, Normalized by $\sigma_y \sigma_z u$ (F Stab)
A	$0.22x(1+0.0001x)^{-0.5}$	$0.20x$	210	200	2	30.7
B	$0.16x(1+0.0001x)^{-0.5}$	$0.12x$	153	120	4	26.8
C	$0.11x(1+0.0001x)^{-0.5}$	$0.08x(1+0.0002x)^{-0.5}$	105	73	5	14.0
D	$0.08x(1+0.0001x)^{-0.5}$	$0.06x(1+0.0015x)^{-0.5}$	76	38	6	6.3
E	$0.06x(1+0.0001x)^{-0.5}$	$0.03x(1+0.0003x)^{-1}$	57	23	>6	2.9
F	$0.04x(1+0.0001x)^{-0.5}$	$0.016x(1+0.0003x)^{-1}$	38	12	>6	1.0

E. Summaries and Comparisons

Tables D.12, D.13, D.15-D.31 (Appendix) are summaries of survey responses by each professional group, mockup category, and geographic region. Mockup category C bases were excluded from this analysis since they were a comparatively small group, containing a possible variety of bases, that had not participated in the original survey, and consequently little information was available.

Discussed in this section are those questionnaire items where the consensus or divergence of the tabulated values was significant. Interval data summaries are discussed where the parameter or design characteristic had particular significance to an air quality management alternative. Summaries of interval data were prepared using arithmetic means and standard deviations cross-tabulated by Mockup Category and Geographic Region.

1. Facility Design Features and Location

Of primary importance were facility design characteristics, including: smoke abatement, burn surface diameter, and facility construction date or date the facility was first placed into use. Possible differences between categories and geographic regions with respect to the following firefighter training facility location parameters were also investigated: distance between the burn facility and installation property line, distance to the nearest on-base facility, and distance to the closest off-base facility or frequently visited area.

The nine USAF Firefighter Training Facilities equipped with waterspray smoke abatement systems were uniformly distributed with

respect to geographic region and mockup category (Table 6.11). Based on the survey data, and discussions during site visits, it appeared that the decision to include a smoke abatement system was made at the base-level in most cases. Also pollution regulatory agency (PRA) interest and involvement was, in most instances, at the local level rather than EPA national or regional offices. New facilities were being constructed with the smoke abatement system option only if it was required or requested by the local PRA. The waterspray smoke abatement system concept and design have been available since 1972. The standard design for USAF Firefighter Training Facilities, including the smoke abatement option, has been periodically updated and revised (Kwan, 1981; Martin Marietta, 1986).

Table 6.11

Facilities Equipped With Smoke Abatement System
Presented by Mockup Category and Geographic Regions

Study Division	Sample Size	No. Facilities With Smoke Abatement	No. Facilities Without Smoke Abatement
No.of Bases	76	9	67
Mockup Category			
A	43	4	39
B	28	4	24
C	5	1	4
By Region			
I-IV	25	3	22
V-VII	27	3	24
VIII-X	24	3	21

The construction dates of live-fire training facilities were not related to geographic or mission aircraft factors (Table D.40, Appendix). Comparisons of region, mockup category, and construction date did not identify any areas or mockup types that had received considerably more new construction than other areas of the country.

There was a difference of about 15% in burn basin diameter between mockup categories A and B (Table D.41, Appendix). According to AFR 92-1 guidance, category B mockups for fighter and trainer sized aircraft should have a smaller diameter training pit to adequately simulate aircraft crash/rescue emergency response conditions for the smaller aircraft. Guidance presented in the regulation, indicates that Category A facilities, utilized for simulation of bomber, tanker and transport aircraft crash/rescue firefighter response, should have about a 95 ft diameter (7000 ft^2) burn area. Likewise, Category B facilities should be approximately 61 feet in diameter (3000 ft^2 fuel spill area), or pit diameters about 36% smaller than training facilities simulating large aircraft fire scenes. The large standard deviations observed in all divisions can be attributed to the larger than expected pit diameters provided by the fire departments.

Regionally there was a notable difference in the diameter of burn facilities. The burn surface diameters of facilities in regions V-VII were about 30% smaller. This difference was possibly due to the larger number of category B bases in that geographic region of the country. Of all bases in regions V-VII 41% were category B, versus 30% and 32% category B bases in regions I-IV and VIII-X respectively.

There was no category or regional difference in the proximity of firefighter training facilities to installation property line, or on-

base facilities (Table D.42, Appendix). Most facilities, regardless of mockup size or regional location, are within one mile of the base boundary and within one mile of the nearest occupied on-base facility or area that is frequently visited. Distances from fire training areas to nearest off-base visited area or occupied facility varied with geographic region. This difference was notable at several bases in the Western region of the country which were more remote and in less densely populated areas. One fire training area in region I-IV was reported to be 30 miles from the nearest off-base facility or populated area.

2. Environmental Impact Considerations

There were no significant differences within or between study variables concerning attitudinal responses related to environmental inpact or problems with respect to firefighter training activities (Tables D.12 and D.13, Appendix). There was a consensus that the USAF should take positive steps to reduce air emissions from all firefighter training facilities. There was disagreement with the statement that the "environmental problem" associated with practice fires was one of public relations rather than one of the emission of hazardous levels of air pollutants, with one exception. Responses in region V-VII were bimodal "Agree"/"Disagree". No reason could be found for this possible difference.

3. Training Effectiveness Opinions

Only the fire chiefs expressed agreement with the statement that firefighter performance in a real aircraft crash fire would not suffer because of training at smoke abated training facilities. Of the three groups of professionals, fire department personnel should be more

qualified, based on their education, training, and experience, to make determinations of firefighter training effectiveness, but it was interesting to note the difference of opinion between the professionals. In mockup category A and geographic regions I-IV, there was also agreement with this opinion. This was contrary to the feelings of the other responders. No reason could be found for the apparent difference of opinion about firefighter performance that could be related to mockup size or area of the country. Compared to the overall modal values for all subjects responding, no differences were observed when data were cross-tabulated by category and regions regarding questions about the effectiveness of smoke abated training fires and the importance of dense black smoke to firefighter training.

4. Feasibility of Management Alternatives

Presented below in order of decreasing arithmetic mean of the five point differential rating scale, are the candidate air quality management alternatives evaluated by the professional groups taking part in this study (Table 6.12). On the rating scale, "5" equated to the alternative being "PRACTICAL", and 1 meant the alternative was "IMPRACTICAL" at their base.

Table 6.12

Feasibility of Air Quality Management Alternatives
(Listed in order by decreasing mean of all responses received)

Management Alternative	Mean	Stnd Dev	Mode	Reference Appendix D Table No.
Use Meteorological Burn/No-Burn Criteria	4.04	1.02	5	D.27
Build New Smoke Abated Facility	2.86	1.32	4	D.18
Decrease Quantity of Fuel Burned	2.83	1.22	2	D.20
Relocate Facility to Remote Area	2.81	1.41	3	D.23
Add Smoke Abatement To Present Facility	2.54	1.22	2	D.19
Send Firefighters to Training Centers	2.52	1.43	1	D.24
Become A Regional Training Center	2.49	1.27	1	D.25
Decrease Number of Training Fires	2.46	1.20	2	D.21
Replace Live-Fire Training With Simulators	2.39	1.15	1/2	D.22
Stop Live-Fire Training AF-Wide	1.37	0.74	1	D.26

No significant differences were found and no underlying reasons for a different application of any of the management alternatives were discovered during site visits or through the analysis of questionnaire data that could be related to aircraft mockup size or region of the country that have not already been discussed.

5. Opinions on Current Air Quality Management

Opinions about current air quality management aspects of firefighter training facilities and their use are listed in Table 6.13 by decreasing order of arithmetic mean for all responses received. The rating scale ranged from "5" (Strongly Agree), down to "1" (Strongly Disagree). No differences in any statements about current air quality management were considered meaningful with respect to mockup size or geographic distribution.

Table 6.13

Opinions on Current Air Quality Management
(Listed in order by decreasing mean of all responses received)

Items - Description	Mean	Stnd Dev	Mode	Reference Appendix D Table No.
More Standardization & Better Regulation	3.91	0.95	4	D.30
More Management Attention	3.61	0.87	4	D.31
Effective Management Could Reduce Emissions	3.27	0.88	4	D.29
Current Regulations Are Effective	2.71	0.87	2	D.28

6. Facilities Currently Shut Down

Considering the small number of facilities currently not operating due to environmental contamination potentials, a judgement as to any mockup size or regional differences or trends is not warranted and would be inconclusive. Generally, it was observed that closed facilities are independent of facility mockup size or regional location (See Table D.43, Appendix).

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

Air pollution emission estimates, calculated from fire department facility use data, showed there were 4 installations that release over 100 tons of criteria air pollutants annually from their firefighter training facilities. While air pollution emissions from training fires are not continuous, a practice fire burning 300 gallons of Jet Petroleum Fuel #4, releases an estimated 1 ton of criteria pollutants to the atmosphere during a 1 to 5 minute period. The frequency of training fires at the bases investigated varied from 4 to 134 fires per year and each burned 100 to 2000 gallons of fuel per training fire or session.

This research has shown that better air quality management can reduce annual air emissions from training fires more effectively than installing smoke abatement systems. Firefighter training session planning, scheduling, and coordinating can also potentially result in a more effective and better standardized training program.

Evaluation and analysis of the available data showed that USAF firefighter training facility design, use, and operation vary widely and are not well standardized. Base officials responsible for environmental protection programs may have inadequate data for decision making under current record keeping and information reporting systems. It is clear that fire chiefs, bioenvironmental engineers, and environmental protection officers often have different perceptions of firefighter

training facility activities and practices at their bases. Each of these individuals is in a position to deal directly with private citizens, as well as federal, state, or local PRA Officials. They should receive and diseminate the same information in a consistent manner. Equally important, decision makers need to be correctly informed to make proper determinations on environmental protection and management.

A. Environmental Air Quality Management Guidelines

The air quality management guidelines developed in this investigation are applicable to all base level firefighter training programs as well as the DOD Fire School (Chanute Technical Training Center, Chanute AFB, IN), other military services, and public/private sector firefighter training facilities and programs. The participants in this study did not always agree on individual management options. Some alternatives were considered to be more feasible than others.

1. Engineering Controls

Installation of smoke abatement systems for air pollution control was not strongly supported by these professionals. Cost of engineering controls, training realism, system maintenance, and new facility construction approval/funding delays were frequently cited reasons why smoke abatement had not been installed. It was found that air quality management practices offer greater potential air emission reductions than the current firefighter training facility smoke abatement technology.

A local in-house engineering design modification, implemented at one newly constructed training facility, has the potential to reduce air

pollution and groundwater contamination. This modification divided the circular burn surface area into four equal quadrants with concrete curbing. Each of the four 90° sectors can be flooded with water and charged with fuel independently. Aircraft crash/rescue training can be conducted using only one-quarter of the fire training basin. In theory, the 4-segment burn pit might use 75% less fuel and result in a 75% reduction in air emissions if only one pit segment is used per training fire. RECOMMENDATION: Segmenting the facility burn surface should be investigated for possible inclusion in the USAF standard design package.

2. Source Isolation and Facility Siting

In the past, firefighter burn pits could usually be located in a remote section of the installation. Now, however, modern firefighter training areas require water, sewer, and electric utilities. Extending these utilities to a remote location can be economically prohibitive.

The current site selection criteria (Martin Marietta, "Site Selection Guide", 1986) are primarily intended to avoid surface and groundwater contamination. However, these recommendations do advise selecting a site where the prevailing wind direction would normally blow smoke away from residential areas. Meteorological factors pertaining to trainee and facility equipment orientation and location at the site are also discussed. RECOMMENDATION: Expand current siting guidelines to include consideration of air pollution dispersion distances as well as prevailing wind direction. The facility should be located where atmospheric dispersion models predict the lowest reasonable potential exposure for off-base or on-base populations.

3. Process Modification and Facility Utilization

a. Stop Live-Fire Training AF-Wide

This is not a practical management alternative.

b. Develop Training Simulators

The microcomputer firefighter training simulator currently being developed by AFESC has great potential to supplement (rather than replace) base-level training programs. All fire department personnel interviewed felt this simulator will greatly enhance their training programs but will not eliminate the need for live-fire training. RECOMMENDATION: After the firefighter training simulator is fielded, the required frequency of live-fire training, specified in AFR 92-1, should be re-evaluated and reduced if possible.

c. Decrease Quantity of Fuel Burned

The quantity of fuel needed to create a realistic live-fire training environment is a function of the fire supression technique employed, the fire extinguishing agent used, and firefighter experience and teamwork. Discussions with fire training experts during site investigations indicated that 250-300 gallons of JP-4 is enough to create a realistic aircraft crash fire environment. Neither geographic regions nor aircraft mockup types influenced the amount of fuel required per training fire. RECOMMENDATION: Based on this study, fire departments should not use more than 300 gallons of fuel per practice fire.

d. Decrease Number of Training Fires

(1). Number of Personnel Trained Per Fire

Based on survey responses and discussions with fire

department personnel, 20 firefighters is an optimal number to train (actively take part) or evaluate in aircraft crash/rescue fire suppression techniques. RECOMMENDATION: At each base, a goal should be established to train 20 firefighters in each live-fire training session.

(2). <u>Number of Times Firefighters Are Trained</u>

Ten percent (10%) of the personnel at the average USAF fire department are apprentice firefighters who require aircraft crash/rescue live-fire training quarterly. The other firefighters are trained semi-annually. Current training requirements averaged out over the typical fire department could be satisfied with 3 training fire experiences per person per year. RECOMMENDATION: Each firefighter should be trained an average of 3 times per year. This will satisfy current career upgrade and proficiency level training requirements.

(3). <u>Number of Training Fires</u>

The number of required training fires per year is a function of the number of firefighters assigned to each fire department, and is independent of regional differences. RECOMMENDATION: Determine the number of fires required annually for training using the equation:

No. Fires/Year = No. Firefighters Assigned x 3/20

e. <u>Annual Air Emissions Reduction Potential</u>

Burning 300 gallons of fuel per fire, training 20 firefighters per practice fire, and training each firefighter an average of three times per year, would yield an estimated annual reduction in air pollution of 69.5%. Fire emissions per base could be reduced from 40 to about 12 tons per year if the guidelines were adopted. Further, if proposed air quality management guidelines were implemented in

addition to installation of a waterspray smoke abatement system, 82.8% reduction in annual emissions from firefighter training fires could be realized. Table 7.1 compares the potential for reduction in air pollution between smoke abatement systems and the management guidelines suggested in this study.

f. Adopt Burn/No-Burn Meteorological Criteria

Most fire department personnel interviewed were not aware that about 1 ton of air pollutants are emitted per 300 gallons of JP-4 burned in a training fire. Additionally, many of the burn/no-burn weather criteria currently being used are for firefighter safety and do not necessarily reflect weather conditions that affect the dispersion of air emissions.

Table 7.1

Air Emission Reduction

[Installing Smoke Abatement Systems]

Pollutant	Without Smoke Abatement System	With Smoke Abatement System	Reduction
Carbon monoxide	>560 lbs	284 lbs	>49.3%
Particulate matter	128	17.6	86.2
Hydrocarbons	320	276*	13.8
Nitrogen dioxide	4.1	0.01	99.7
Total	>1012.2	577.6	>42.9%

* hydrocarbon estimates based on: Ristau and Lehman, 1975, p 28; Rote and Wangen, 1975, p 69.

[Implementing Air Quality Management Guidelines]

Option	Current USAF Average	Management Guidelines Adopted	Reduction
Fires/year/base	26	12	53.8%
Gallons/Fire	502	300	40.2
FUI Tons AP/year	40.0	12.2	69.5%

[Implement AQM Guidelines and Install Smoke Abatement]

	Current USAF Average	Implement AQM Guidelines	Install Smoke Abatement	AQM & Smoke Abatement
FUI	40 T/yr/base	12.2 T/yr/base	22.8 T/yr/base	7.0 T/yr/base
% reduction	0%	69.5%	42.9%	82.5%

Since meteorological forecasting capability and historical weather data exist at base-level Air Weather Service organizations, annual or seasonal predictions of weather conditions related to atmospheric assimilative capacity are available to planners and schedulers of fire department training fires. With these forecasts, supervisors could better pre-plan and schedule required practice fires on at least an annual basis. Some scheduling flexibility must remain to permit firefighter training during a reasonable range of weather conditions that occur at each installation. Few bases had included meteorological criteria into local policy or procedural documentation. A wide range of weather conditions were being used as burn/no-burn decision criteria but few of these were standard from installation-to-installation. RECOMMENDATION: Fire department personnel should consult with weather service personnel to select meteorological burn/no-burn decision criteria. These criteria should also be reviewed with EPO, BEE, and PRA officials.

g. <u>Train Other Emergency Response Teams</u>

This management alternative was not considered desirable by base professionals. However, expanding the use of the fire training area to other special emergency or environmental response teams seems worthwhile since this practice could potentially increase the number of possible sources of construction and maintenance funds. Also, rather than constructing different training areas for other field training exercises such as nuclear weapons accidents, oil/fuel spill recovery, hazardous materials accident response, and chemical warfare defense gas mask confidence training, the base's live-fire training area could be

designated a joint-use facility. RECOMMENDATION: The Air Force training community should investigate the feasibility of joint purpose training facilities.

h. Establish A Network Of Regional Training Centers

Travel expenses, backfilling fire departments with temporary firefighters, the necessity for dedicated training firetrucks, and temporary billeting were some of the more common arguments against this option. From an air pollution standpoint, while the overall air emissions from practice fires might decrease nationally, they could greatly increase regionally or at least at the designated training center. These network facilities would operate more often due to training requirements of several bases versus just their own. Some fire departments and BEEs indicated they would expect to have problems with PRA officials if they were to be designated a MAJCOM or regional training center.

A similar alternative which evolved during the course of this work might be of benefit regionally. Upper-level USAF managers responsible for selecting and funding construction of environmentally acceptable live-fire training areas might consider locating the new facilities in regions that currently have environmental pollution problems. This would be particularly beneficial to bases where live-fire training is currently suspended due to PRA activity. New facility construction planning could be done on a MAJCOM or regional basis to pick bases where the new facility would do the most good for the greatest number of firefighters. RECOMMENDATION: Select bases for new facilities on the basis of greatest Command or regional need.

i. Conduct Joint-Training With Public Fire Departments

Encouraging joint-use agreements with community fire departments, hosting military aircraft crash/rescue training workshops, and featuring base firefighter equipment and capabilities during open-house activities could result in a better understanding of the need for practice fires and at the same time foster improved base-community relations. PRA officials could be invited to witness a training session. Where local joint-use agreements exist, the PRA having jurisdiction should be made aware of the number of fire departments benefiting from the use of the facility, and the total number of firefighters trained. This research indicates that joint training agreements are common in the fire protection community. More publicity and education of PRA officials regarding this practice would improve community and agency relations. RECOMMENDATION: Continue fostering community good will through joint-use of firefighter training facilities.

B. Implications for Future Policy and Actions

This work showed that there is a concensus among base-level fire chiefs, BEEs and EPOs that more standardization, better regulation, and more management attention to firefighter training facility use and operation is needed.

1. Improved Recording and Reporting Practices

For preparation of accurate air emissions inventories, a consistent definition of the number of annual training fires, or a reliable method for determining the actual quantity of fuel burned annually for firefighter training is needed. It is more difficult to determine the

actual quantity of fuel burned if a fire department burns waste JP-4 only, or waste and new fuel, rather than only new JP-4. New JP-4 fuel, requisitioned through normal fuel supply channels, provides a record of the amount of fuel burned in practice fires. Recording and reporting procedures can be improved by redefinition or a uniform interpretation and application of current definitions of what constitutes a firefighter training experience and training fire. RECOMMENDATION: Improve facility use data and firefighter training recording and reporting procedures.

2. More Management Attention Is Needed

Increased involvement of BEE and EPO resources would improve air quality management of firefighter training activities. RECOMMENDATION: Pre-burn notification and occasional direct observation by those responsible for environmental management and protection would do much to eliminate the current differences in perceptions regarding live-fire training practices at base level.

3. Management Guidelines Summarized

Table 7.2 is a summary of the air quality management guidelines developed in this work. Training fire throughput parameters and management indices.

Table 7.2

Air Quality Management Guidelines and Recommendations

1.	Limit the quantity of fuel burned to 300 gallons per training fire.
2.	Train 20 firefighters per training fire.
3.	Conduct fires per year = number of firefighters assigned x 3/20.
4.	Document meteorological burn/no-burn criteria.
5.	Continue and expand joint-use agreements with local fire departments.
6.	Expand Use of fire training area to other emergency teams.
7.	Increase BEE and EPO involvement and improve coordination.
8.	Prioritize new construction on a Command or Regional need basis.

C. Implications for Future Research

1. Monitoring/Sampling

No sampling or monitoring at practice fires had been attempted at any base. No evaluations have been conducted as part of firefighter training facility research and development efforts since 1976. Fuel blends and additives have changed since the current emission factors were estimated from very limited laboratory testing.

Sampling should be conducted to verify currently used emission factors and personnel exposure potentials. Attention should be given to recent concerns about PAH and BAP in practice fire emissions and dispersion of fugitive soot particles.

2. Dispersion Modeling

Presently the two computer dispersion models that firefighter

practice fire emission estimated and dispersion forecasting capability, are of limited value because of the uncertainties in input data, emission factors, short-term duration, and magnitude of the source strength.

An episodal dispersion model, capable of incorporating Carson-Moses bouyant plume rise calculations, should be validated for use as a guideline model for practice fires.

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APPENDIX A

Appendix A.1

ID No. USAF SCN 86-57 (expires 30 SEP 86)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

Subject: Firefighter/Crash-Rescue Training Facility Survey 12 June 1986

To: Base Civil Engineer/DE

1. Your help is needed! Eighty-seven USAF Fire Departments are being asked to participate in a nationwide survey of Firefighter/Crash-Rescue Training Facilities being carried out in the Department of Environmental Sciences & Engineering by an active duty Air Force Institute of Technology doctoral student. The purpose of this mailed survey is to gather design, use, and operational information about as many Firefighter Training Failities as possible. The data will be used to determine the extent of training nationwide, to estimate annual air pollutant emissions, and to calculate USAF averages and standard indices to facilitate doing comparative analyses. In a second phase of this research, management options designed to reduce air emissions will be developed and evaluated for feasibility by interviewing knowledgeable and experienced USAF officers, planners, and managers in Fire Prevention, Environmental Protection, and Bioenvironmental Engineering.

2. To protect confidentiality in research, names of respondents will not be released or used in any publications associated with this research. Further, specific Bases, MAJCOMs, States, and EPA Air Quality Control Regions will not be revealed; rather, they have been assigned identification numbers. Your Base's ID # appears in the upper lefthand corner of each page of the survey. This survey is subject to the Privacy Act of 1974. This study has been coordinated with the Air Force Engineering Services Center, Tyndall AFB, FL and approved by the Military Personnel Center Survey Branch, Randolph AFB, TX.

3. Participation is voluntary; however, since Firefighter Training Facility design, use and operations differ greatly throughout the Air Force, and since the study results must be comprehensive and as accurate as possible, the **importance of receiving your Fire Department's completed survey cannot be overemphasized!** Without their response the accuracy of the study would be decreased and possibly lead to erroneous conclusions and inappropriate recommendations of future air quality management alternatives. A stamped-addressed return envelope is included for the respondent's convenience.

4. **Please have the survey completed and returned immediately.** If you have any questions please contact me at the above address, or at 919+966-2677. Thank you in advance for your kind consideration and your organization's valuable time.

Respectfully,

3 atchs: 1. Survey Instructions
2. Survey Form
3. Return Envelope

RICHARD E. BREWER, Major, USAF BSC

Appendix A.1(cont')

ID No. USAF SCN 86-57 (expires 30 SEP 86)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

Subject: Firefighter/Crash-Rescue Training Facility Survey, Second Request — 7 July 1986

To: Base Civil Engineer/DE

1. You can still help! I have received very encouraging participation in response to the mailed survey sent out to eighty-seven Air Force Bases on 12 June 1986. So far completed surveys from forty-nine bases (56%) have been mailed back. Unfortunately to date, I have not received a response from your base. I am sending this second request, hoping that you will please consider having your Fire Department complete the short six page survey form and return it to me. With your assistance the accuracy of this Air Force Engineering Services Center sponsored research effort can be greatly improved.

2. Your base's response to the mailed survey is very important to insuring an accurate picture can be developed detailing the magnitude of live-fire firefighter training currently being conducted in the Air Force. Even if your base has suspended this training, it is important for them to complete the entire survey form as accurately as posible and specify in Section A5d, how they are receiving their periodic training.

3. Please have the survey form that was sent to you in the 12 June 1986 package completed and returned immediately in the previously provided stamped envelope. If you need a new copy of the US Air Force Firefighter/Crash-Rescue Training Facility Design, Operation, and Use Survey package please call me at 919+966-2677 or write to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

4. Thank you for your cooperation, and I anxiously await your kind response!

Respectfully,

RICHARD E. BREWER, Major, USAF BSC

Appendix A.1(cont')

ID No. USAF SCN 86-57 (expires 30 Sep 86)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

2 September 1986

Subject: Firefighter/Crash-Rescue Training Facility Survey, Third & Final Request

To: Base Civil Engineer/DE

1. Time is running out, but you can still help! My USAF approved (SCN 86-57) Firefighter/Crash-Rescue Training Facility Survey questionnaire is valid through 30 September 1986. I have received responses from almost 60% of the 87 USAF Base Civil Engineers requested to participate. Unfortunately, I have not received a completed questionnaire about your Fire Department's live-fire training area. Won't you please reconsider participating in this environmental management research study - your base's input is needed to insure the validity and accuracy of this effort. I'd like to have a 100% response rate! Can your Fire Department take a few minutes to help?

2. If your base is not conducting firefighter training due to environmental regulatory agency activity or due to any other reasons, it is still essential to my research to hear from you. If training has ceased at your base please have at least Sections A, 5, a thru d completed - if you would like to provide the other information requested, please do so and indicate that you are not however currently conducting live-fire training. Also, it would be helpful to know how and where your firefighters are satisfying their periodic training requirements during the time your facility is not able to be used.

3. For your convenience I have enclosed another copy of the survey package in case the original mailing has been misplaced. Please mail the completed survey to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

Respectfully,

RICHARD E. BREWER, Major, USAF BSC

Appendix A.2

ID No. USAF SCN 86-57 (expires 30 SEP 86)

US AIR FORCE FIREFIGHTER/CRASH-RESCUE TRAINING FACILITY DESIGN, OPERATION, AND USE SURVEY

SURVEY INSTRUCTIONS

1. Completion of the survey should take less than 30-45 minutes. Your name will not be released to anyone, or used in any reports or publications resulting from this survey. Bases, MAJCOMs, States, or EPA Air Quality Control Regions have been assigned pseudonyms or numbers for analytical and comparative purposes.

2. In this survey, Firefighter/Crash-Rescue, Firefighter, or Fire Protection Training Facilities or Areas are the same and refer to any sites on your installation where live-fire training environments are created for the purpose of training firefighters and/or other emergency response teams/personnel. The survey requests detailed information about EACH Firefighter Training Facility that has been used at your installation since January 1984. If you will be responding about more than one fire training burn area, please reproduce Sections B, C, and D of the survey form prior to beginning.

3. Please complete Sections A, B, C, and D of the survey form. If additional space is needed for you to answer the few responses requesting descriptions, please use the back of the survey form or attach additional paper indicating the applicable Section letter and Item number. Data requested in the survey should be available in your training schedules and personnel records, Base Master Plans and Tabs, Installation Maps or Crash Maps, Installation Restoration Program Phase I Reports, and Fire Department management records. Should difficulty be encountered in completing any item on the survey, it might be helpful to contact your Civil Engineering Environmental Protection Officer, or the Medical Service Bioenvironmental Engineer.

4. After you have kindly completed the survey form for each of your Firefighter Training Facilities or live-fire training locations that has been used since January 1984, fold the form(s) and any additional paper used to answer description questions, and put them in the stamped envelope provided and mail at once! If you have any questions or need additional information please do not hesitate to call me at 919+966-2677, or write to me at the following address:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Richard E. Brewer, Major, USAF BSC
University of North Carolina
Chapel Hill, North Carolina 27514

* * * * * * * * * * THANK YOU FOR YOUR TIME AND PARTICIPATION! * * * * * * * * * *

PRIVACY ACT STATEMENT

The survey is subject to the Privacy Act of 1974. Authority: 10 USC 8012; 44 USC 3101; Executive Order 9397. Principal purpose: to collect basic design, use, and operational data about USAF Firefighter/Crash-Rescue Training Facilities in the Contintental USA. Routine use: calculate annual air emission estimates for particulates, hydrocarbons, carbon monoxide, and oxides of nitrogen resulting from live-fire training programs. Disclosure is voluntary; however, since Firefighter Training Facility design, use and operations differ greatly throughout the nation, and since the study results must be comprehensive and as accurate as possible, the importance of receiving your completed survey cannot be overemphasized! Without your response the accuracy of the study would be decreased and possibly lead to erroneous conclusions and inappropriate recommendations of future air quality management alternatives.

Appendix A.2(cont')

ID No.

US AIR FORCE FIREFIGHTER/CRASH-RESCUE TRAINING FACILITY DESIGN, OPERATION, AND USE SURVEY

The Respondent Identification you give in Section A will ONLY be used to contact you for possible follow-up information. YOUR name will NOT appear in any published project documents NOR be released to any requestor. Additionally, in lieu of using real names of Bases, MAJCOMs, States, and EPA Air Quality Control Regions, identification numbers have been assigned. See upper lefthand corner for your number.

Section A. Respondent Identification & General Information

1. Name: ______________________________

2. Duty Title: ______________________________

3. Organization Mailing Address: ______________________________

____

4. Phone Number Autovon ____________ Commercial ____________

5. Basic Fire Department & Training Information:

a. Give the number of firefighters presently assigned to your department: ______ military, and ________ civilian.

b. Indicate the number of these firefighters that receive live-fire training at your training facility(ies). __________ How many times per year is each individual live-fire trained? ______.

c. About how many individuals (firefighters, crash/rescue, medical, maintenance, etc) are trained in a single typical fire? ______.

d. If you are not currently conducting live-fire training at your base, where do your personnel receive their periodic proficiency training? ______________________________

e. Do personnel from other bases receive periodic refresher training (not initial career entry level training) at your base facility? Circle: yes or no. List the Bases and approximate number of visiting personnel trained per year: ______________________________

____

f. Do any public/non-military fire departments use your facility? Circle: yes or no. Approximate number trained per year ______.

Appendix A.2(cont')

ID No.

****
*   *
*   In the sections that follow, detailed information is   *
*   requested on EACH Firefighter/Crash-Rescue Training   *
*   Facility that has been used at your installation since   *
*   January 1984. If you will be responding about more than   *
*   one burn facility, please reproduce the survey data forms   *
*   before beginning.   *
*   *
****

** Our base has _______ active firefighter training area(s).
** The following information pertains to training area number _______.

Section B. Firefighter/Crash-Rescue Training Facility Design Information

1. Indicate the approximate date the training area was constructed or first used._____

2. Diameter of the burn facility. The diameter of the burn pit area that is actually used for the fire. This may or may not be the actual physical diameter of the facility. Give units of measure.
Diameter:______________(units).

3. Circle letter corresponding to best description of burn surface:

   a. Compacted soil/sand   b. Compacted clay
   c. Crushed rock   d. Concrete pad
   e. Gravel   f. Asphalt
   g. Other (describe):______________________________

4. Circle the general class of aircraft simulated/modeled in your Firefighter Training Facility and emergency response scenario:

   a. Tanker   b. Bomber   c. Transport
   d. Fighter   e. Trainer   f. Rotary wing
   g. No aircraft   h. Other (describe):_______________

5. Briefly describe the construction of structural or aircraft mockups used at the training area. ______________________________
____
____

6. Circle most accurate description of fuel dispensing system used to dose/charge fire training facility:

   a. Manually dosed from fuel bowser
   b. Gravity flow from holding tank thru single distribution hose.
   c. Gravity flow thru piping system with _____ (number) outlets.
   d. Pumped thru single hose to burn surface.
   e. Pumped underground dosing system with _____(number) outlets.
   f. Other (describe):______________________________
   ____

Appendix A.2(cont')

ID No.

7. Is facility equipped with a smoke abatement system? Circle: Yes or No
   If yes, briefly describe (eg water-spray, flow rate): ____________

Section C. Firefighter Training Facility Operational Parameters

1. Select the letter corresponding to the best description of the fuel used for firefighter training fires.

   a. Waste JP-4 (contaminated with less than 10% impurities)
   b. New JP-4
   c. Vehicle gasoline (MOGAS)
   d. Diesel fuel
   e. No 2 fuel oil
   f. Av gas
   g. Other (specify): ____________

2. Is the fuel to be burned tested for impurities by a laboratory (such as the Base Fuels Laboratory, etc) before use? Circle: Yes or No.

3. Give the average number of gallons of fuel used on the burn surface per training fire. Or if significant variation has occurred over time, indicate quantity of fuel used per training fire by year.

   Average (if no variation since 1984). ________ gal/fire
   -OR-
   During 1984 ________ gal/fire
   During 1985 ________ gal/fire
   In 1986 ________ gal/fire

4. The quantity of fuel burned in a training exercise is determined by? Check one: ___Metering, or ___estimating, or ___other. If "other", please describe: ____________

5. Enter the most common time of day that a training fire is ignited.
   ________hrs

6. Duration of a typical live-fire training session:

   Average time taken to extinguish one training fire: ______mins
   Number of re-ignitions of same fuel pool: ________

Appendix A.2(cont')

ID No.

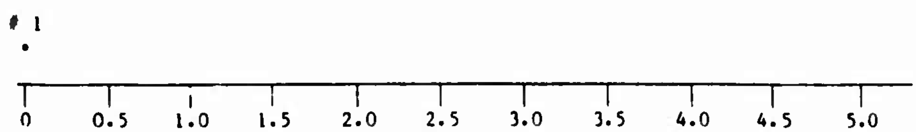
7. In the table below indicate the number of training fires for each month over the last two (2) years, and the anticipated number of fires for the remainder of this year and next.

<u>Number of Training Fires per Month</u>

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984												
1985												
1986												
1987												

8. If you consider a typical fire training day at your installation, indicate on the timeline below:

   (#1) time of fuel application to pit surface
   (#2) time of first ignition
   (#3) time period between re-ignitions (if any)
   (#4) time at which fuel is either fully consumed by fire, pumped, drained, or removed from the burn facility.



Elapsed time, hrs

(beginning with fuel application to burn facility surface as #1)

Appendix A.2(cont')

ID No.

9. Circle letter corresponding to best description of method used to remove fuel/water/foam mixture from the Firefighter Training Facility after completion of exercise/training period.

   a. Facility is drained into a holding pond or evaporative basin.

   b. An oil/water separator is used to remove the residual fuel & foam from the waste water prior to discharge to the sanitary sewer. Separator is pumped and contents are disposed of as hazardous waste.

   c. Burn pit contents are pumped out and handled/disposed of as hazardous waste.

   d. Residual fuel/foam/water mixture is left in the burn pit to evaporate and weather in place.

   e. Residuals are collected on sorbent material and removed to an area and allowed to air dry.

   f. All remaining fuel and foam are ignited and allowed to completely burn after the day's firefighter training exercise sessions are completed.

   g. Other. Describe: ____
   ____
   ____
   ____
   ____
   ____
   ____

Section D. Environmental Exposure Potential Information

In this section information is requested about buildings (both off-base and on-base) or facilities such as parks, playgrounds, picnic areas that are frequently occupied by base personnel or the public. Of interest is the proximity of these locations to the Firefighter/Crash-Rescue Training Facility. If you believe it would be easier to show these areas/facilities, distances, and compass directions on a copy of your Crash Grid Map, please do so.

Appendix A.2(cont')

ID No.

1. Describe the proximity of this Firefighter Training Facility to the base perimeter/boundary (giving distance and direction if possible).

2. Identify the off-base populated/visited area(s) that is closest to the Firefighter Training Facility (giving distance(s) and direction(s) if possible).

3. Identify the on-base building(s) or frequently visited area(s) nearest to the training burn area (giving distance(s) and direction(s) if possible).

4. List the meteorological conditions during which a training fire would NOT be ignited (eg precipitation, wind speed, inversion, season):

THANK YOU for taking the time to complete this survey and providing the requested data. Please place the completed form(s) in the provided stamped envelope and mail as soon as possible. After all responses are received, analyzed, and tabulated, an aggregate report will be provided to each base that took part in the survey.

Appendix A.3

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

Firefighter Training Facility: Air Quality Management Survey

To:

1. Thanks for taking time to help me out with the June 86 Firefighter/Crash-Rescue Training Facility Survey (SCN 86-57). I received completed questionnaires from [illegible] of the USAF Fire Departments contacted - I sincerely appreciate you supporting my Doctoral Research Program here at UNC! I am writing to you again to fulfill three purposes: 1) to officially THANK YOU for your help, 2) to ask you to verify/clarify any of your earlier responses that I did not understand or where my question was perhaps unclear, and 3) to ask for your professional opinions regarding air pollution, environmental impact, and training efficiency/effectiveness of USAF firefighter training.

2. It is your professional opinions and attitudes, developed from your technical education/training and firefighting/crash-rescue experience that are essential to the proper and thorough evaluation of candidate Air Quality Management Alternatives that will result from my research. I have already received this type of information, as well as other environmental management data, from your Environmental Coordinator and Bioenvironmental Engineer in a questionnaire this past fall. Now YOUR input will insure that any recommendations I make for USAF environmental air quality management policy changes and Firefighter Training Facility operation/use guidelines will be workable and acceptable to YOU - the USAF Fire Protection Training professionals!

3. These worksheets are divided into three short sections for your convenience and ease of completion. Section A: asks for your verification or clarification of any of your Jun 86 responses I was unsure of. In most cases, the items for clarification deal with the number of training fires conducted per year and the number of gallons of fuel burned in each of these training fires. If I have made no notes in Section A please go on to the next part. Section B: asks for your attitude/opinion about the significance of environmental air quality or air pollution released during live-fire Firefighter/Crash-Rescue Training, and your evaluation of my research candidate air quality management alternatives as they may impact training realism and effectiveness. Section C: presents some follow-on questions to the Jun 86 survey that deal with your local Firefighter Training program coordination and management.

4. I would appreciate your timely response, by 6 Mar 87, if possible. I'm hoping I can count on you again to help with this environmental research effort. Thanks for your continued support!

Sincerely,

2 atchs: 1. Worksheets
2. Stamped Return Envelope

RICHARD E. BREWER, Major, USAF BSC
Graduate Student

Appendix A.4

ID No.

ENVIRONMENTAL AIR QUALITY MANAGEMENT ALTERNATIVES:
USAF FIREFIGHTER/CRASH-RESCUE TRAINING FACILITIES

ITEM CLARIFICATION & FOLLOW-UP QUESTIONS

ABOUT

US AIR FORCE FIREFIGHTER/CRASH-RESCUE TRAINING FACILITY
DESIGN, OPERATION & USE SURVEY
(USAF SCN 86-57)

for

USAF FIRE PROTECTION TRAINING OFFICERS

To protect confidentiality in research, names of respondents will NOT be released or used in any publications associated with this research. Additionally, specific Air Force Bases, MAJCOMs, States, and EPA Air Quality Control Regions will NOT be revealed; rather, each base has been assigned an identification number. Your Base's ID # appears in the upper lefthand corner of each survey sheet.

This research is being conducted by:

Major Richard E. Brewer
Department of Environmental Sciences & Engineering
School of Public Health - 201 H
University of North Carolina
Chapel Hill, North Carolina 27514

Appendix A.4(cont')

ID No.

SECTION - A -

ITEM CLARIFICATION

US AIR FORCE FIREFIGHTER/CRASH-RESCUE TRAINING FACILITY
DESIGN, OPERATION & USE SURVEY

1. In your previous survey response you gave information that I understood to mean the following: ______________________________

1a. Is that right? Please circle: YES or NO.

1b. If NO, please correct me ______________________________

2. In your previous survey response you gave information that I understood to mean the following: ______________________________

2a. Is that right? Please circle: YES or NO.

2b. If NO, please correct me ______________________________

3. In your previous survey response you gave information that I understood to mean the following: ______________________________

3a. Is that right? Please circle: YES or NO.

3b. If NO, please correct me ______________________________

Appendix A.4(cont')

ID No.

Section - B -

ASSESSMENT OF YOUR PROFESSIONAL ATTITUDES/OPINIONS

and

EVALUATION OF ENVIRONMENTAL MANAGEMENT ALTERNATIVES

INTRODUCTION: This section seeks YOUR professional attitudes and opinions for use in evaluating feasibility and practicality of a range of possible environmental management alternatives that are designed to reduce or eliminate air emissions from USAF Firefighter Training Facilities.

1. From the list below, circle the letter(s) corresponding to the statement(s) you believe is(are) true with respect to your installation's firefighter training facility operation.

   a. Emission of Air Pollutant(s) [eg Carbon Monoxide, Oxides of Nitrogen, Total Suspended Particulates, Sulfur Oxides, Organic Hydrocarbons, Ozone, and Lead] is(are) significant.

   b. Emission of Criteria Pollutant(s) is(are) insignificant.

   c. Potential for groundwater contamination is significant.

   d. Potential for groundwater contamination is insignificant.

   e. The potential to contaminate soil and eventually groundwater is far more significant than the potential adverse air quality impact.

Appendix A.4(cont')

ID No.

2. Complete each of the following attitudinal response items by circling the value which most closely represents YOUR OPINION concerning training effectiveness and environmental concerns with respect to USAF Firefighter Training Facilities (FFTFs).

Item	Your Attitude/Opinion: Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
a) Only fires without air pollution controls can be used to adequately train firefighters	5	4	3	2	1
b) Dense black smoke is the single most important characteristic of a training fire	5	4	3	2	1
c) Performance in real air-craft crash fires will not suffer because of training at smoke-abated FFTFs	5	4	3	2	1
d) The USAF should take positive steps to reduce air emissions from ALL FFTFs	5	4	3	2	1
e) FFTF operation & use should be more standardized & better regulated AF-wide	5	4	3	2	1
f) Current Regs are effectively limiting FFTF air emissions	5	4	3	2	1
g) More management attention to use/operation of FFTFs is needed	5	4	3	2	1
h) FFTF air emissions could be reduced by effective air quality management in lieu of installation of costly air pollution controls	5	4	3	2	1
i) The "environmental problem" associated with FFTFs is one of public relations rather than emission of hazardous levels of air pollutants	5	4	3	2	1

Appendix A.4(cont')

ID No.

3. Drawing upon your professional experience and expertise as a USAF Fire Protection Training Officer, evaluate each of the following air quality management alternatives as if each were being considered for implementation at your installation's Firefighter Training Facility. Rank/score each of the following air quality management alternatives by circling the appropriate number on the provided semantic differential rating scale that best indicates your opinion.

Management Alternative	Your Opinion About the Alternative				
	Practical (5)	(4)	Neutral (3)	(2)	Impractical (1)
a) Build new smoke abated FFTF	5	4	3	2	1
b) Add Air Pollution Controls to existing FFTF	5	4	3	2	1
c) Decrease quantity of fuel burned	5	4	3	2	1
d) Decrease number of training fires	5	4	3	2	1
e) Relocate facility in a remote area of the base	5	4	3	2	1
f) Send firefighters TDY to regional training center	5	4	3	2	1
g) Having your base serve as a regional training center	5	4	3	2	1
h) Stop live-fire training AF-wide	5	4	3	2	1
i) Develop training simulators to replace live-fire burn pits	5	4	3	2	1
j) Adopt meteorological go/no-go criteria to insure optimum dispersion conditions during training fires	5	4	3	2	1

k) List any of the above (or other) air quality management alternatives already implemented at your base that pertain to the operation & use of the FFTF (if none, so state): ______________________

____

l) Comments/remarks: ______________________________

____

Appendix A.4(cont')

ID No.

4. From a Fire Protection Training standpoint, could your present training facility be used for any additional form(s) of emergency or disaster response training conducted at your installation (eg Oil Spill, Hazardous Material Spill Response, Gas Mask Confidence, or Broken Arrow) ?

   Check one: ___ YES ___ NO ___ NO OPINION

   Remarks/comments: ____
   ____
   ____
   ____
   ____

5. Answer this question from a Fire Protection Training point of view. Could your base, with its present fire training facility, serve as the site for a Regional or MAJCOM Firefighter Training Center that would be used by several base's Fire Departments for live-fire training?

   Check one: ___ YES ___ NO ___ NO OPINION.

   Briefly state reason: ____
   ____
   ____
   ____

Appendix A.4(cont')

ID No.

SECTION - C -

FOLLOW-UP QUESTIONS

1. Has your MAJCOM issued supplemental environmental protection guidance for firefighter training facilities? Circle: YES NO or DON'T KNOW.

   1a. If YES, identify (eg MAJCOM Supplement to AFR XX-XX, Command Policy Letter, etc): ______________________________

2. Does your installation have local written environmental protection procedures or written policy concerning the firefighter training facility? Circle: YES NO or DON'T KNOW.

   2a. If YES, briefly describe: ______________________________

3. Is each live-fire session at the training facility coordinated with base agencies prior to burning? Check best estimate:

   _____ always (= 100%)
   _____ frequently (> 50%, < 100%)
   _____ occasionally (> 0%, < 50%)
   _____ never (= 0%)

   3a. Name the base agencies typically contacted: ______________________________

4. Is each live-fire training session coordinated with off-base pollution control agencies prior to burning? Check one:

   _____ always (= 100%)
   _____ frequently (> 50%, < 100%)
   _____ occasionally (> 0%, < 50%)
   _____ never (= 0%)
   _____ don't know

Appendix A.4(cont')

ID No.

5. Has your office received complaints concerning firefighter training facility operation? Circle one: YES or NO.

   5a. If YES, briefly describe ______________________________
   ____
   ____

6. Have you ever personally been trained at a smoke-abated live-fire training facility? Circle: YES NO or DON'T KNOW

   6a. IF YES, please describe the smoke-abated training's acceptability or unacceptability. ______________________________
   ____
   ____
   ____

7. What is (are) the most important characteristic(s) of a training fire to insure firefighters receive acceptable periodic training? ________
____
____
____
____

THANK YOU for taking the time to complete this survey and providing the requested information. Please place the completed form in the provided envelope and mail as soon as possible.

Appendix A.5
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	CLS	EPA/ FEMA Rgn	FFTF Shut Down	CNSTDT, Date 1st Used	PITDIA, ft	Surface Mat'l	Type of Fuel Disp Sys	Smoke Abtmnt Sys
34809	1	5	0	1976	99	gumbo	5	0
54709	1	9	0	1976	150	e	5	0
13805	1	5	0	n/r	n/r	n/r	n/r	n/r
15001	1	10	0	1985	200	a	5	0
71009	1	3	0	1950	125	a	5	0
123709	1	5	0	1985	100	a	5	0
143209	1	1	0	1981	86	b	3	0
152509	1	3	0	n/r	75	a	3	0
164709	1	9	0	1968	50	c	5	0
173509	1	7	0	n/r	n/r	c	5	0
224709	1	9	0	1968	75	a	5	0
13309	2	6	0	1977	200	b,c	5	0
40809	2	6	0	1950	110	a	5	0
60809	2	6	0	1969	85	a,c	5	0
34704	2	9	0	1956	300	a	5	0
90409	2	10	0	1978	90	a	5	0
101709	2	8	0	1960	150	a,g	5	0
111909	2	2	1	1986	214	c,d	5	0
132909	2	5	0	1965	38	d	5	0
202209	2	1	0	1977	75	b	5	0
211909	2	2	0	n/r	50	a	3	0
61602	2	5	0	1980	50	c	5	1
242909	2	5	0	1984	115	b,c,d	5	0
11507	3	6	0	1982	150	c	5	0
23107	3	3	0	1971	150	a,b	2	0
10904	3	4	0	1971	96	a,c	7	0
41107	3	4	0	1986	50	c,d	5	0
14103	3	4	0	1976	76	c,d	3	0
54407	3	3	0	n/r	n/r	a,e	5	0
25001	3	10	0	1984	200	c	5	0
84211	3	4	0	1977	75	c,d	5	0
42705	3	4	0	1981	90	d,e	5	[illegible]
62007	3	6	0	1975	100	a	5	0
74807	3	6	0	1987	100	a	5	0
15105	3	4	0	1975	50	e	6	0
80407	3	10	0	1976	137	b	5	0
34702	3	9	1	n/r	n/r	n/r	n/r	n/r
23803	3	5	0	1982	67	e	4	0
14610	3	8	0	1977	75	a	5	0
111807	3	4	n/r	n/r	n/r	n/r	n/r	0
44102	3	4	0	1972	n/r	d	5	1
123807	3	5	0	1975	60	f	5	0
134707	3	9	1	1962	n/r	a	4	0
43003	3	1	0	1984	75	c	5	1

n/r=no response

FFTF Shut Down: 1=yes, 0=no

Surface Mat'l: a=cmp s/s, b=cmp cly, c=csh rck, d=concrte, e=gravel, f=asphalt, g=other

Type of Fuel Disp Sys: 1=manual, 2=sgl hs, 3=grav, 4=pump, 5=undgrd, 6=truck, 7=other

Smoke Abtmnt Sys: 1=yes, 0=no

Appendix A.5 (cont')
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	Number of Firefighters Mil	Civ	Tot	TOT#TR, # FFs Trained	XTRND, # Times Trnd/yr	FTI(1), # Trnd/fr Calc'd	FTI(2), gal/ff Trnd	#TRSVY, #Trained fm Survey	# Public FFs Trnd/yr
34809	38	22	60	59	4	7.9	44.5	15	0
54709	45	18	63	56	2	2.9	339.3	20	20
13805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15001	58	4	62	62	4	31.0	16.1	15	0
71009	33	24	57	52	4	3.7	161.5	10	20
123709	37	24	61	49	8	9.3	21.4	10	0
143209	50	23	73	71	3	12.5	47.9	7	0
152509	52	13	65	65	12	32.5	15.4	12	0
164709	49	14	63	48	2	6.0	83.3	10	0
173509	45	17	62	40	4	10.0	50.0	8	0
224709	68	72	140	140	4	35.0	8.6	15	40
13309	54	27	81	81	5	15.6	25.7	8	50
40809	50	15	65	50	4	3.8	92.8	7	120
60809	47	23	70	68	2.4	4.3	116.4	10	0
34704	67	71	138	129	4	32.2	31.0	35	0
90409	46	32	78	78	4	7.4	40.4	10	15
101709	38	23	61	56	5	14.0	71.4	18	1
111909	17	45	62	46	4	3.8	130.4	17	1
132909	43	17	60	55	4	7.9	38.2	18	10
202209	47	22	69	51	4	3.6	68.6	8	75
211909	47	23	70	55	20	23.9	72.8	6	100
61602	21	122	143	104	2	7.7	64.9	18	0
242909	44	23	67	44	8	44.0	13.6	17	30
11507	31	31	62	58	8	116.0	17.2	20	19
23107	43	35	78	70	8	24.3	12.3	20	25
10904	6	43	49	32	6	5.8	103.1	10	0
41107	49	17	66	11	4	3.7	81.8	10	0
14103	34	46	80	80	2	12.3	16.2	13	22
54407	39	25	64	64	4	9.1	39.4	12	1
25001	86	3	89	78	4	18.4	54.5	15	0
84211	42	19	61	57	4	11.4	19.3	15	0
42705	37	26	63	60	6	15.0	33.3	20	0
62007	44	66	110	90	4	5.0	100.0	20	50
74807	42	21	63	60	2	8.6	75.8	20	0
15105	59	22	81	76	3	9.9	50.4	10	0
80407	49	22	71	71	2	11.8	53.2	16	50
34702	15	73	88	88	sht dwn	n/r	n/r	28	20
23803	27	41	68	66	4	20.3	24.6	10	1
14610	66	11	77	70	4	9.3	16.1	12	0
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	19	63	82	68	4	30.2	11.6	24	0
123807	48	22	70	56	4	14.0	n/r	12	0
134707	51	14	65	n/r	n/r	n/r	n/r	10	0
43003	50	49	99	99	4	13.2	18.9	10	50

n/r=no response

1=yes
0=no
or # FFs trnd

Appendix A.5 (cont')
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	F/Y, # Fires per yr	G/F, Fuel Burned /fire,gal	FUI, tons AP/yr	Waste JP-4 Burned	Waste JP4 Tested in Lab	Exting Time, mins	# reigns same pool
34809	30	350	35.6	1	1	2.00	1
34709	38	1000	128.7	0	0	1.00	0
13805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15001	8	500	13.5	0	0	3.00	2
71009	56	600	113.8	0	0	1.00	1
123709	42	200	28.5	0	0	.75	0
143209	17	600	34.6	0	0	2.00	0
152509	24	500	40.6	1	1	5.00	1
164709	16	500	27.1	0	0	3.00	1
173509	16	500	27.1	1	1	1.00	2
224709	16	300	16.3	0	0	1.50	0
13309	26	400	35.2	1	0	.50	2
40809	53	350	62.8	1	1	1.50	1
60809	38	500	64.4	1	1	3.00	0
34704	16	1000	54.2	0	0	3.50	2
90409	42	300	42.7	0	1	1.50	0
101709	20	1000	67.7	0	0	2.00	0
111909	48	500	81.3	1	0	.50	0
132909	28	300	28.5	1	1	1.00	0
202209	56	250	47.4	0	1	1.50	3
211909	46	1740	271.1	1	0	2.00	1
61602	27	500	45.7	1	0	5.00	1
242909	8	600	16.3	1	0	1.50	4
11507	4	2000	27.1	1	1	3.00	1
23107	23	300	23.4	1	n/r	1.00	0
10904	33	600	67.1	1	0	1.00	1
41107	12	300	12.2	0	0	2.00	1
14103	13	200	8.8	1	1	3.00	1
54407	28	360	34.1	1	0	.58	0
25001	17	1000	57.6	0	0	3.00	0
84211	20	220	14.9	0	0	1.00	3
42705	24	500	40.6	0	0	1.50	4
62007	72	500	121.9	0	0	1.00	2
74807	14	650	30.8	0	1	1.00	1
15105	23	500	39.0	0	1	2.00	0
80407	12	630	25.6	1	1	2.00	1
34702	n/r	n/r	n/r	n/r	n/r	n/r	n/r
23803	13	500	22.0	1	0	1.50	2
14610	30	150	15.2	1	1	1.00	0
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	9	350	10.7	1	1	2.00	0
123807	16	900	48.8	1	1	1.00	0
134707	n/r	n/r	n/r	1	0	2.00	0
43003	30	250	25.4	1	1	1.50	0

n/r=no response

Waste JP-4 Burned: 1=yes, 0=no
Waste JP4 Tested in Lab: 1=yes, 0=no

Appendix A.5 (cont')
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	Dist to BNDRY, mi	Closest OFBFAC, mi	Closest ONBFAC, mi	Trng Fire Time of Day,hr	Other Trng?	Rgnl Center
34809	.10	2.00	.30	930	1	0
54709	0.00	1.00	.06	1000	n/r	n/r
13805	n/r	n/r	n/r	n/r	n/r	n/r
15001	1.00	6.00	.25	1000	1	1
71009	.30	2.00	1.50	1400	2	0
123709	.25	3.00	.10	1400	1	0
143209	1.50	2.00	.50	1900	0	0
152509	1.00	3.00	.75	1400	1	1
164709	.10	2.50	.50	1000	0	0
173509	.50	.75	.33	900	n/r	n/r
224709	3.00	5.00	1.00	1300	1	0
13309	.25	.25	.125	900	1	0
40809	.10	.50	.50	1400	1	1
50809	.25	.50	.07	1000	1	0
34704	8.00	30.00	1.00	1230	0	1
90409	.15	2.00	.75	900	1	0
101709	.06	n/r	.15	930	0	0
111909	.40	.40	.20	1300	n/r	n/r
132909	n/r	n/r	n/r	1400	n/r	n/r
202209	.25	1.00	.30	1300	n/r	n/r
211909	n/r	n/r	1.00	1000	1	1
61602	.04	4.00	2.00	1000	1	0
242909	.06	none	.20	1330	n/r	n/r
11507	.15	4.00	.30	930	n/r	n/r
23107	.30	.40	.20	930	n/r	n/r
10904	1.90	2.00	.40	1000	n/r	n/r
41107	.12	.75	n/r	1500	1	1
14103	.80	1.25	.20	1030	0	0
54407	.20	2.00	.50	1000	1	0
25001	2.00	2.40	.75	1300	1	1
84211	1.00	1.00	.10	1000	n/r	n/r
42705	n/r	2.00	.04	1330	1	0
62007	3.00	4.00	.60	1000	1	1
74807	.75	2.00	.25	1000	n/r	n/r
15105	.20	1.00	.25	1000	n/r	n/r
80407	.06	.06	.10	900	0	0
34702	n/r	n/r	n/r	n/r	n/r	n/r
23803	.50	.75	1.50	900	0	0
14610	n/r	n/r	n/r	1400	1	0
111807	n/r	n/r	n/r	n/r	n/r	n/r
44102	1.00	1.50	.75	900	1	1
123807	.20	4.00	.20	900	1	1
134707	.20	3.00	.40	900	0	0
43003	.50	3.00	.50	1000	1	1

n/r=no response

Other Trng?: 1=yes, 0=no, 2=no/op

Rgnl Center: 1=yes, 0=no, 2=no/op

Appendix A.5 (cont')
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	MAJCOM Suppl	Written Local Proced	On-Base Coord	On-Base Coord w/ Who	Pre-Burn PRAgncy Coord	Rcvd Complnts	Emission Contamin Opinions
34809	1	0	1	adg	4	0	ad
54709	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15001	1	1	1	acef	1	0	ac
71009	0	0	1	acdefgh	1	0	e
123709	2	1	1	eb	1	0	ad
143209	2	2	1	acd	4	1	ac
152509	0	1	1	e	1	0	bd
164709	0	1	1	acdefg	1	0	ace
173509	n/r	n/r	n/r	n/r	n/r	n/r	n/r
224709	0	0	1	adg	1	0	n/r
13309	2	2	1	afg	5	0	d
40809	1	1	1	n/r	2	1	ac
60809	0	1	1	acdfg	1	0	bd
34704	2	2	1	cefg	5	0	e
90409	0	0	1	acdf	1	0	n/r
101709	0	0	1	acd	4	0	abce
111909	n/r	n/r	n/r	n/r	n/r	n/r	n/r
132909	n/r	n/r	n/r	n/r	n/r	n/r	n/r
202209	n/r	n/r	n/r	n/r	n/r	n/r	n/r
211909	2	n/r	1	ad	4	0	n/r
61602	1	1	1	abcefh	1	0	b,d
242909	n/r	n/r	n/r	n/r	n/r	n/r	n/r
11507	n/r	n/r	n/r	n/r	n/r	n/r	n/r
23107	n/r	n/r	n/r	n/r	n/r	n/r	n/r
10904	n/r	n/r	n/r	n/r	n/r	n/r	n/r
41107	0	1	1	abcd	4	1	e
14103	2	2	1	acdfg	1	0	n/r
54407	0	0	1	all	1	0	ce
25001	0	1	1	acdh	1	1	ac
84211	n/r	n/r	n/r	n/r	n/r	n/r	n/r
42705	0	1	1	be	5	0	bd
62007	1	1	1	abcefg	1	1	n/r
74807	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15105	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80407	0	0	1	acdegh	1	0	a
34702	n/r	n/r	n/r	n/r	n/r	n/r	n/r
23803	0	0	1	cd	1	1	ace
14610	0	2	1	acdfgh	1	0	d
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	2	1	1	acdef	2	0	a
123807	0	0	1	acg	4	0	bd
134707	0	2	1	acdg	4	0	ac
43003	0	1	1	all	1	0	bd
	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=alwys 2=freq 3=occas 4=never	a=ctr twr b=BEE c=bs ops d=SP e=EPO f=hosp g=cmd pst h=weather	1=alwys 2=freq 3=occas 4=never	1=yes 0=no	a=+NAAQS b=-NAAQS c=+gnd wt d=-gnd wt e=gwt>AP

Appendix A.5 (cont')
Fire Department Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base	[ref: FD Phase II Survey pg 4] <-- Training/Environment Concerns-->									[ref: FD Phase II Survey pg 5] <--- AQ Management Alternatives-->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
34809	1	2	4	4	4	2	4	3	2	3	4	2	2	2	2	2	1	2	4
54709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15001	2	3	3	4	2	2	4	3	2	1	2	2	1	1	1	5	1	3	5
71009	2	1	2	5	4	1	3	3	2	5	1	2	2	2	2	3	1	1	4
123709	5	2	2	2	2	3	2	3	4	1	1	2	1	1	1	1	1	1	5
143209	2	2	4	5	5	2	4	2	2	4	4	3	3	3	4	2	2	3	3
152509	4	2	5	3	4	3	3	3	4	2	2	2	1	5	1	3	1	1	4
164709	2	2	4	4	4	2	4	3	2	4	4	2	2	2	2	2	1	2	4
173509	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
224709	5.	5	2	2	5	2	5	4	5	1	1	1	1	1	1	1	1	1	5
13309	2	2	2	3	5	3	5	2	2	3	5	1	1	3	1	3	1	1	3
40809	2	2	4	4	4	3	4	2	3	4	4	1	1	3	4	5	1	3	4
60809	2	1	4	2	4	1	4	2	3	1	4	2	2	1	1	1	1	2	3
34704	5	3	1	3	4	4	5	4	4	2	4	1	1	2	1	1	1	1	5
90409	n/r	2	n/r	2	2	2	3	2	2	3	2	1	1	1	1	1	1	1	4
101709	3	1	2	2	5	1	5	4	1	1	1	4	2	5	1	2	1	1	5
111909	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
132909	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
202209	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
211909	n/r	1	4	4	4	3	4	4	2	3	3	1	1	1	1	5	1	5	3
61602	2	1	4	4	4	2	4	4	2	1	5	2	1	1	1	3	1	1	5
242909	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
11507	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
23107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
10904	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
41107	2	2	4	2	4	3	4	2	2	5	5	2	2	1	3	1	1	2	4
14103	2	2	2	5	5	3	4	4	2	4	4	1	1	5	5	5	1	3	4
54407	2	2	4	3	5	2	3	3	2	4	3	2	2	4	2	2	1	2	4
25001	3	1	4	4	5	2	3	2	3	4	1	1	1	1	4	4	1	2	4
84211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
42705	2	2	4	2	4	3	2	3	4	1	4	1	1	4	1	1	4	4	4
62007	1	1	1	4	5	2	5	5	2	5	1	5	5	3	5	5	1	1	5
74807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15105	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80407	3	2	3	5	3	4	3	3	2	4	4	2	2	4	2	2	2	4	4
34702	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
23803	4	2	3	4	4	2	4	4	4	3	3	4	4	1	1	1	1	1	5
14610	4	2	3	2	3	4	3	5	4	2	2	2	2	3	2	2	1	3	5
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	4	2	4	4	4	4	4	2	4	4	4	3	4	5	4	4	1	1	3
123807	1	1	5	5	5	3	1	1	1	5	1	1	1	5	1	1	1	1	5
134707	1	1	4	4	4	3	3	3	2	4	1	2	1	5	1	1	1	3	3
43003	2	2	4	4	4	4	4	3	3	5	5	1	1	4	5	5	1	1	5

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	4 = Practical

Appendix A.6
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	CLS	EPA/ FEMA Rgn	FFTF Shut Down	CNSTDT, Date 1st Used	PITDIA, ft	Surface Mat'l	Type of Fuel Disp Sys	Smoke Abtmnt Sys
10811	4	6	0	1957	50	a,e	5	unk
22011	4	6	0	1978	40	c,d	5	0
34911	4	9	0	1960	100	e	5	0
43311	4	6	0	1976	99	b,d	5	0
54711	4	9	0	1960	50	a	5	0
14008	4	9	0	1978	50	c	5	1
10702	4	8	1	n/r	200	d	5	0
104911	4	9	0	1981	100	a	5	0
114211	4	4	0	1947	60	a	6	0
124111	4	4	0	1950	50	a,b	5	0
133911	4	10	0	1955	80	a,e	5	0
141111	4	4	0	1979	62	a,e	5	0
152311	4	9	0	1986	50	d,e	5	1
74204	4	4	0	1984	100	d	5	0
33803	4	7	0	1973	100	d	3	0
161811	4	4	0	1976	100	a	5	0
171111	4	4	0	1971	100	e	none	0
35001	4	10	0	1983	75	f	6	0
51502	4	6	0	1983	75	d	5	1
184211	4	4	0	1979	75	e	5	1
232609	4	7	1	1940	35	e	5	0
134905	4	9	0	1982	80	e	3	0
22705	5	4	0	1942	60	e	5	0
62011	5	6	0	n/r	100	a,c,e	5	0
60805	5	6	1	1967	30	e	5	0
90805	5	6	1	1984	60	d	5	0
100805	5	6	0	1971	60	d	5	0
110805	5	6	0	1984	60	d,e	5	0
121505	5	6	0	1982	57	e	5	0
n/r=no response			1=yes 0=no			a=cmp s/s b=cmp cly c=csh rck d=concrte e=gravel f=asphalt g=other	1=manual 2=sgl hs 3=grav 4=pump 5=undgrd 6=truck 7=other	1=yes 0=no

Appendix A.6 (cont')
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	Number of Firefighters Mil	Civ	Tot	TOT#TR, # FFs Trained	XTRND, # Times Trnd/yr	FTI(1), # Trnd/fr Calc'd	FTI(2), gal/ff Trnd	#TRSVY, #Trained fm Survey	# Public FFs Trnd/yr
10811	45	12	57	57	4	17.5	8.6	16	0
22011	40	21	61	56	4	8.0	37.5	15	0
34911	46	24	70	67	4	8.9	33.6	22	0
43311	48	17	65	60	4	7.7	51.7	10	0
54711	44	21	65	65	8	32.5	15.4	65	60
14008	26	38	64	52	10	14.9	13.5	15	1
10702	21	87	108	108	4	10.0	49.8	21	1
104911	47	25	72	60	8	20.0	30.0	30	200
114211	54	28	82	78	4	6.2	48.1	7	8
124111	39	21	60	46	16	61.3	8.2	12	0
133911	44	22	66	59	10	15.5	32.2	10	28
141111	46	25	71	67	2	16.8	14.9	20	0
152311	60	24	84	64	4	7.5	66.4	10	20
74204	39	27	66	57	2	4.6	32.9	18	0
33803	21	46	67	60	5	25.0	4.0	3	0
161811	n/r	n/r	65	60	n/r	n/r	n/r	n/r	150
171111	47	15	62	50	4	50.0	30.0	8	0
35001	48	0	48	39	20	97.5	9.2	10	0
51502	17	83	100	74	6	14.8	23.6	n/r	0
184211	50	24	74	71	6	n/r	n/r	15	100
232609	37	15	52	48	6	n/r	n/r	20	0
134905	39	25	64	60	28	52.5	5.7	20	0
22705	47	18	65	60	4	1.8	55.8	6	0
62011	56	55	111	100	5	20.8	24.0	15	0
60805	34	27	61	57	n/r	n/r	n/r	15	0
90805	49	19	68	68	4	10.5	33.5	12	25
100805	36	32	68	64	n/r	n/r	n/r	6	0
110805	40	22	62	55	7	21.4	23.4	15	0
121505	0	67	67	57	2	9.5	82.9	13	25

n/r=no response

1=yes
0=no
or # FFs
trnd

Appendix A.6 (cont')
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	F/Y, # Fires per yr	G/F, Fuel Burned /fire,gal	FUI, tons AP/yr	Waste JP-4 Burned	Waste JP4 Tested in Lab	Exting Time, mins	# reigns same pool
10811	13	150	6.6	0	n/a	2	0
22011	28	300	28.5	1	1	1.5	1
34911	30	300	30.5	1	1	1	0
43311	31	400	42.0	0	n/a	1.5	1
54711	16	500	27.1	1	0	4	0
14008	35	200	23.7	0	n/a	.5	10
10702	43	500	72.8	0	n/a	2	0
104911	24	600	48.8	1	0	1	1
114211	50	300	50.8	0	n/a	.5	0
124111	12	500	20.3	0	n/a	2	2
133911	38	500	64.4	1	1	.5	2
141111	8	250	6.8	0	n/a	.5	0
152311	34	500	57.6	1	0	1	0
74204	25	150	12.7	0	n/a	2	0
33803	12	100	4.1	1	1	.5	0
161811	4	500	6.8	0	n/a	1	2
171111	4	1500	20.3	0	n/a	.75	0
35001	8	900	24.4	0	n/a	2.5	3
51502	30	350	35.6	1	0	3	3
184211	n/r	300	n/r	0	n/a	.5	0
232609	sht dwn	300	n/r	0	n/a	1.5	2
134905	32	300	32.5	0	n/a	.5	2
22705	134	100	45.4	1	1	1	0
62011	24	500	40.6	1	1	2	2
60805	8	500	n/r	1	0	1	3
90805	26	350	30.8	1	1	1.25	0
100805	23	300	23.4	0	n/a	3	2
110805	18	500	30.5	1	0	1.25	2
121505	12	788	32.0	1	1	.75	2
n/r=no response				1=yes 0=no	1=yes 0=no		

Appendix A.6 (cont')
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	Dist to BNDRY, mi	Closest OFBFAC, mi	Closest ONBFAC, mi	Trng Fire Time of Day,hr	Other Trng?	Rgnl Center
10811	n/r	n/r	n/r	1800	n/r	n/r
22011	.2	7	2	1400	n/r	n/r
34911	1	1.75	.3	900	1	0
43311	.2	4	.6	1030	1	1
54711	.2	4	1	800	1	0
14008	.4	1.65	.6	1330	1	0
10702	.06	n/r	n/r	1000	1	1
104911	.25	7	.5	900	0	0
114211	n/r	n/r	1.5	1900	0	0
124111	.5	.5	1.5	1700	n/r	n/r
133911	1	3.5	.2	900	1	0
141111	.5	1	.5	1900	1	0
152311	.5	4	.25	900	1	0
74204	.1	1	.1	930	0	0
33803	.08	.1	.25	1300	n/r	n/r
161811	.25	1	.25	900	1	0
171111	.25	2	.25	930	1	0
35001	.5	none	n/r	945 / 1615	0	0
51502	n/r	3	1	1400	n/r	n/r
184211	1	5	1	1830	n/r	n/r
232609	.5	2	.25	1000	n/r	n/r
134905	.5	14	n/a	900	1	1
22705	.75	none	.1	1900	1	0
62011	.75	7	none	900 / 1800	1	0
60805	.6	1	.4	900	n/r	n/r
90805	.25	1.5	1	1700	n/r	n/r
100805	.2	2	1	1000	n/r	n/r
110805	.9	1.4	.2	900	n/r	n/r
121505	.06	1.5	.15	930	1	0

n/r=no response

Other Trng?: 1=yes, 0=no, 2=no/op
Rgnl Center: 1=yes, 0=no, 2=no/op

Appendix A.6 (cont')
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	MAJCOM Suppl	Written Local Proced	On-Base Coord	On-Base Coord w/ Who	Pre-Burn PRAgncy Coord	Rcvd Complnts	Emission Contamin Opinions
10811	n/r	n/r	n/r	n/r	n/r	n/r	n/r
22011	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34911	0	1	1	abcdefgh	1	0	ac
43311	1	1	1	n/r	1	0	bde
54711	1	1	2	abdg	1	0	n/r
14008	0	1	1	agh	4	0	n/r
10702	0	2	1	adg	1	0	ad
104911	1	1	1	acdef	1	0	e
114211	1	0	1	acdg	4	0	ce
124111	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	1	0	1	acfgh	4	1	e
141111	1	1	1	acfgh	4	0	bd
152311	1	1	1	n/r	1	0	d
74204	2	2	1	all	1	0	d
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	1	1	1	abfg	2	0	n/r
171111	2	1	1	adfh	4	0	n/r
35001	2	2	1	abcdfg	4	0	bce
51502	n/r	n/r	n/r	n/r	n/r	n/r	n/r
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134905	0	0	1	abcdg	1	0	n/r
22705	0	0	1	acdfg	4	0	bd
62011	0	1	1	acg	1	1	c
60805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
90805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
100805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
110805	n/r	n/r	n/r	n/r	n/r	n/r	n/r
121505	2	0	1	acdefg	1	0	ad
	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=alwys 2=freq 3=occas 4=never	a=ctr twr b=BEE c=bs ops d=SP e=EPO f=hosp g=cmd pst h=weather	1=alwys 2=freq 3=occas 4=never	1=yes 0=no	a=+NAAQS b=-NAAQS c=+gnd wt d=-gnd wt e=gwt>AP

Appendix A.6 (cont')
Fire Department Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base	[ref: FD Phase II Survey pg 4] <-- Training/Environment Concerns-->									[ref: FD Phase II Survey pg 5] <--- AQ Management Alternatives-->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
10811	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
22011	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34911	2	1	4	1	3	2	2	2	2	5	1	1	1	1	1	1	1	1	1
43311	1	1	1	5	5	5	3	3	4	3	5	2	1	1	2	4	1	1	3
54711	2	2	3	3	4	2	4	2	2	5	5	1	1	5	1	1	1	1	1
14008	1	1	5	3	5	1	5	5	5	1	1	1	5	5	1	1	5	1	5
10702	2'	2	3	4	4	3	4	2	2	4	2	1	1	5	4	4	1	2	5
104911	2	3	2	2	4	4	4	4	4	4	4	2	2	3	2	3	1	1	4
114211	5	2	2	5	5	5	5	5	5	5	2	1	1	1	1	1	1	5	5
124111	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	2	2	3	3	3	3	4	3	2	2	4	3	2	4	3	2	1	2	5
141111	2	2	4	4	3	4	3	2	2	5	2	1	1	4	1	1	1	2	3
152311	2	2	4	4	4	2	3	2	3	4	4	2	1	2	1	1	1	1	4
74204	1	3	2	3	4	4	4	3	2	3	4	2	2	3	2	3	1	3	4
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	5	5	2	3	4	4	2	4	4	2	3	1	1	5	1	2	1	1	1
171111	5	4	1	4	5	4	4	4	4	3	1	5	1	5	1	1	1	1	4
35001	2	2	5	5	5	2	5	5	1	5	1	1	1	5	1	1	1	1	5
51502	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134905	4	4	2	2	4	2	2	4	4	2	2	2	2	2	2	2	1	2	2
22705	5	4	1	1	3	1	2	3	2	1	1	3	1	1	1	3	1	1	5
62011	3	3	2	2	4	3	3	3	2	3	3	2	1	2	1	1	1	1	3
60805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
90805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
100805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
110805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
121505	2	2	4	4	2	2	2	2	2	4	4	2	1	1	1	1	1	4	3

Training/Environment Concerns:
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

AQ Management Alternatives:
1 = Impractical
3 = Neutral
4 = Practical

Appendix A.7
Fire Department Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	CLS	EPA/ FEMA Rgn	FFTF Shut Down	CNSTDT, Date 1st Used	PITDIA, ft	Surface Mat'l	Type of Fuel Disp Sys	Smoke Abtmnt Sys
50805	6	6	0	n/r	20	d	4	0
90511	7	3	0	1963	200	c	6	0
92107	7	2	1	1977	75	c,e	5	0
104707	7	9	0	1982	100	g	5	0
24709	8	9	0	n/r	n/r	n/r	n/r	1
44204	8	4	unk	n/r	n/r	n/r	n/r	n/r
80109	8	8	unk	n/r	n/r	n/r	n/r	n/r
74211	8	4	unk	n/r	n/r	n/r	n/r	n/r
20802	8	6	unk	n/r	n/r	n/r	n/r	n/r
84705	8	9	unk	n/r	n/r	n/r	n/r	n/r
181709	8	8	unk	n/r	n/r	n/r	n/r	n/r
192409	8	7	unk	n/r	n/r	n/r	n/r	n/r

n/r=no response

FFTF Shut Down: 1=yes, 0=no

Surface Mat'l: a=cmp s/s, b=cmp cly, c=csh rck, d=concrte, e=gravel, f=asphalt, g=other

Type of Fuel Disp Sys: 1=manual, 2=sgl hs, 3=grav, 4=pump, 5=undgrd, 6=truck, 7=other

Smoke Abtmnt Sys: 1=yes, 0=no

Appendix A.7 (cont)
Fire Department Data
Study Category C
Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	Number of Firefighters Mil	Civ	Tot	TOT#TR, # FFs Trained	XTRND, # Times Trnd/yr	FTI(1), # Trnd/fr Calc'd	FTI(2), gal/ff Trnd	#TRSVY, #Trained fm Survey	# Public FFs Trnd/yr
50805	37	22	59	54	4	9.0	11.1	10	100
90511	47	26	73	64	3	19.2	26.0	10	30
92107	41	24	65	48	4	n/r	n/r	6	0
104707	43	26	69	48	6	16.0	20.3	18	200
24709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44204	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84705	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
181709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
192409	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r

n/r=no response

1=yes
0=no
or # FFs trnd

Appendix A.7 (cont')
Fire Department Data
Study Category C
Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	F/Y, # Fires per yr	G/F, Fuel Burned /fire,gal	FUI, tons AP/yr	Waste JP-4 Burned	Waste JP4 Tested in Lab	Exting Time, mins	# reigns same pool
50805	24	100	8.1	1	1	3	7
90511	10	500	16.9	0	n/a	2	0
92107	sht dwn	500	n/r	1	0	.3	2
104707	18	325	19.8	1	1	2.25	0
24709	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44204	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84705	n/r	n/r	n/r	n/r	n/r	n/r	n/r
181709	n/r	n/r	n/r	n/r	n/r	n/r	n/r
192409	n/r	n/r	n/r	n/r	n/r	n/r	n/r

n/r=no response

Waste JP-4 Burned: 1=yes 0=no; Waste JP4 Tested in Lab: 1=yes 0=no

Appendix A.7 (cont')
Fire Department Data
Study Category C
Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	Dist to BNDRY, mi	Closest OFBFAC, mi	Closest ONBFAC, mi	Trng Fire Time of Day,hr	Other Trng?	Rgnl Center
50805	1	1	.5	900	1	0
90511	3	5	.5	1300	0	0
92107	.5	.8	.8	1300	0	0
104707	.4	.4	.25	900	1	0
24709	n/r	n/r	n/r	n/r	n/r	n/r
44204	n/r	n/r	n/r	n/r	n/r	n/r
80109	n/r	n/r	n/r	n/r	n/r	n/r
74211	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r
84705	n/r	n/r	n/r	n/r	n/r	n/r
181709	n/r	n/r	n/r	n/r	n/r	n/r
192409	n/r	n/r	n/r	n/r	n/r	n/r
n/r=no response					1=yes 0=no 2=no/op	1=yes 0=no 2=no/op

Appendix A.7 (cont')
Fire Department Data
Study Category C
Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	MAJCOM Suppl	Written Local Proced	On-Base Coord	On-Base Coord w/ Who	Pre-Burn PRAgncy Coord	Rcvd Complnts	Emission Contamin Opinions
50805	2	1	1	bdfg	1	0	bd
90511	0	0	1	af	4	0	d
92107	0	0	1	abdegh	5	0	bd
104707	0	1	1	acdfg	1	1	ad
24709	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44204	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84705	n/r	n/r	n/r	n/r	n/r	n/r	n/r
181709	n/r	n/r	n/r	n/r	n/r	n/r	n/r
192409	n/r	n/r	n/r	n/r	n/r	n/r	n/r
	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=alwys 2=freq 3=occas 4=never	a=ctr twr b=BEE c=bs ops d=SP e=EPO f=hosp g=cmd pst h=weather	1=alwys 2=freq 3=occas 4=never	1=yes 0=no	a=+NAAQS b=-NAAQS c=+gnd wt d=-gnd wt e=gwt>AP

Appendix A.7 (cont')
Fire Department Data
Study Category C
Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base	[ref: FD Phase II Survey pg 4] <-- Training/Environment Concerns-->									[ref: FD Phase II Survey pg 5] <--- AQ Management Alternatives-->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
50805	2	2	2	2	3	4	2	4	3	1	2	3	2	3	1	2	2	3	3
90511	1	5	3	4	4	4	4	4	2	3	3	1	1	3	3	1	3	5	3
92107	3	2	3	3	4	3	4	3	3	4	3	1	1	3	4	3	1	2	3
104707	2	2	3	4	4	4	2	2	4	4	4	1	4	1	1	1	1	1	4
24709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44204	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84705	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
181709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
192409	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	4 = Practical

APPENDIX B

Appendix B.1

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

5 November 1986

Subject: Firefighter Training Facility: Air Quality Management Survey

To: Environmental Protection Officer
Civil Engineering/DEV

Bioenvironmental Engineer
USAF HOSP/SGPB

1. I need your help! Please participate in a nationwide survey of environmental management practices pertaining to USAF Firefighter Training Facilities. I am an active duty Bioenvironmental Engineer currently in an Air Force Institute of Technology PhD program. My research is being carried out in the Department of Environmental Sciences & Engineering, University of North Carolina at Chapel Hill. I have received USAF approval to administer this survey by mail (USAF SCN 86-117). Also, this management research has been coordinated with the Air Force Engineering Services Center, at Tyndall AFB, Fl. Last summer, seventy-eight Air Force Fire Departments took part in Phase I of this study which gathered facility design, use and operational data.

2. This portion of the study, Phase II, is designed to analyze USAF compliance with Federal, State and local regulatory agency requirements, and to have YOU (the cognizant experts) evaluate the feasibility/practicality of candidate air quality management alternatives. The Environmental Protection Officers and Bioenvironmental Engineers are being given different forms. Some of the questions are the same, but the two surveys are designed to focus on your primary area of responsibility. I need to hear from both of you separately!

3. It should take you about 30 minutes to complete the survey. The information requested should be in already existing documentation. It ISN'T my intent to have you prepare or generate new information. If some of the information requested is not available, or is unknown to you, please state that in the space provided. There is no need to consult regulatory agencies or other base offices regarding specific information requested. This survey is a measure of YOUR involvement with air quality/environmental management aspects related to live-fire firefighter/crash-rescue training activities. To protect confidentiality in research, your name will not be used in any reports resulting from this study, nor will your name be released to any requester.

4. Please complete at once and return it to me in the provided stamped addressed envelope by 26 Nov 86. Thank you in advance! I sincerely appreciate your help with my AFIT research. If you have any questions or would like additional information, please write, or call me at (919)+966-2677.

Respectfully,

3 atchs: 1. Survey Instructions
2. Survey Form
3. Return Envelope

Richard E. Brewer, Major, USAF BSC

Appendix B.1(cont')

ID No. USAF SCN 86-117 (expires 31 Dec 86)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

9 December 1986

Firefighter Training Facility: Air Quality Management Survey, Second Request

Bioenvironmental Engineer
USAF Hospital/SGPB

1. You can still help! I have received very encouraging response to the survey sent to Environmental Protection Officers (EPOs) and Bioenvironmental Engineers (BEEs) at eighty-five Air Force Bases. So far completed surveys from fifty EPOs (59%) and forty-three BEEs (51%) have been mailed back. I received your EPOs completed survey; but unfortunately, I have not gotten your response. I am sending this second request, hoping that you will please complete the previously provided blue survey form and return it to me. With your assistance the accuracy of this Air Force Engineering Services Center sponsored research effort can be greatly improved.

2. Your response is very important to insure an accurate picture can be developed detailing air pollution control and environmental management aspects of firefighter training currently being conducted in the Air Force. Even if your base has suspended this training, it is still important for you to complete the entire survey form as accurately as possible (please specify that training fires have been suspended or discontinued and add a short note as to why the training has been stopped, eg groundwater contamination, IRP Phase II wells, EPA action, or State air pollution regulations/restrictions, etc).

3. Please complete the blue questionnaire I sent to you in the 5 NOV 86 package and return it in the previously provided stamped envelope. If you need a new copy of the survey package please call me at 919+966-2677 or write to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

4. Thanks for your support, and I anxiously await your kind response!

Respectfully,

RICHARD E. BREWER, Major, USAF BSC

Appendix B.1(cont')

ID No. USAF SCN 86-117 (extended, expires 31 JAN 87)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

7 January 1987

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

Firefighter Training Facility: Air Quality Management Survey, Third Request

Bioenvironmental Engineer
USAF Hospital/SGPB

1. There's a little more time! I have received a survey expiration date extension to 31 JAN 87 from HQ AFMPC for my Air Quality Management Survey. The original request and complete survey package was sent out to eighty-seven (87) Air Force Bases on 5 November.

2. I have received surveys from 67% of the contacted Environmental Protection Officers (EPOs) and 60% of the Bioenvironmental Engineers (BEEs) asked to participate in this survey. However, I still have not gotten your response. With the extension, you now have a few more days to join your fellow Bioenvironmental Engineers and take part in this nationwide survey. I'm sending this final request and another survey form, hoping you will find time to complete it and mail it back to me. Your response is quite important to my Air Force Institute of Technology (AFIT) doctoral research efforts here at the University of North Carolina.

3. As I mentioned in the second letter, even if your base has curtailed live-fire firefighter training, I still need to hear from you. Information about those bases where this training can't be conducted due to environmental or other constraints is most significant to my investigations. If this is the case at your base, please specify that training fires have been suspended or discontinued and provide a brief explanation why the training has been stopped, eg groundwater contamination, IRP Phase II wells, EPA action, or State air pollution regulations/restrictions, etc.

4. Please complete the enclosed blue questionnaire and return it in the provided envelope. If you have any questions or need additional information, please call me at 919+966-2677 or write to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

Respectfully,

3 atchs: 1. Instructions
2. Blue survey form
3. Return envelope

RICHARD E. BREWER, Major, USAF BSC

Appendix B.2

ENVIRONMENTAL AIR QUALITY MANAGEMENT ALTERNATIVES: USAF FIREFIGHTER/CRASH-RESCUE TRAINING FACILITIES

SURVEY INSTRUCTIONS

1. This is a nationwide survey of environmental air quality management aspects of conducting live-fire training for USAF firefighters and crash-rescue personnel. Completion of the survey should take about 30 minutes of your time. Participation is voluntary and your identity will not be used in any reports or publications resulting from this research.

2. Please complete the survey form as completely as possible. If additional space is needed for you to answer the few responses requesting descriptions, please use the back of the survey or attach additional paper indicating the applicable question number.

3. This is a questionnaire about <u>your</u> involvement in air quality management aspects of <u>your base's</u> firefighter training facility/program and you are not being asked to research answers outside your office for any questions you do not know the answer to. Both the Bioenvironmental Engineer and the Environmental Protection Officer from eighty-seven (87) bases are being asked to participate. If you do not know the answer to any of the questions please indicate where appropriate.

4. After completing the survey form, place it and any additional paper used to answer description questions, in the stamped envelope provided and mail at once! THANK YOU!!

Richard E. Brewer, Major, USAF BSC
Department of Environmental Sciences & Engineering
School of Public Health - 201 H
University of North Carolina
Chapel Hill, North Carolina 27514
919+966-2677

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

ENVIRONMENTAL AIR QUALITY MANAGEMENT ALTERNATIVES:
USAF FIREFIGHTER/CRASH-RESCUE TRAINING FACILITIES

ENVIRONMENTAL MANAGEMENT QUESTIONNAIRE

for

USAF BIOENVIRONMENTAL ENGINEERS

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PRIVACY ACT STATEMENT

The information gathered in this survey is subject to the Privacy Act of 1974. Authority: 10 USC 8012; 44 USC 3101; Executive Order 9397. Principal purpose: to collect data about the environmental management of US Air Force Firefighter/Crash-Rescue Training Facilities. Routine use: develop and evaluate environmental air quality management alternatives to reduce or eliminate air emissions resulting from live-fire training programs. Disclosure is voluntary; however, since Firefighter Training and Environmental Management Programs differ from base-to-base, between MAJCOMs, and between States or Air Quality Regions, the importance of your responses cannot be overemphasized! Without your participation the accuracy of the study would be decreased and possibly lead to erroneous conclusions and inappropriate recommendations of future air quality management alternatives.

****

To further protect confidentiality in research, names of respondents will NOT be released or used in any publications associated with this research. Additionally, specific Air Force Bases, MAJCOMs, States, and EPA Air Quality Control Regions will NOT be revealed; rather, each base has been assigned an identification number. Your Base's ID # appears in the upper lefthand corner of each survey sheet.

This research is being conducted in the Department of Environmental Sciences & Engineering, School of Public Health, at the University of North Carolina at Chapel Hill. The work is sponsored by and has been coordinated with the Air Force Engineering Services Center, Tyndall AFB, FL.

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

SECTION - A -

Respondent Identification & General Information

```
**********************************************************************
*                                                                    *
*    Completion of Section A is voluntary.  Your name,               *
*    mailing address, and phone number will ONLY be used to          *
*    contact you for possible follow-up information or               *
*    clarification of responses. YOUR name will NOT appear           *
*    in any published project documents NOR be released to          *
*    any requester.                                                  *
*                                                                    *
**********************************************************************
```

1. Name: ______________________________

2. Duty Title: ______________ ______________

3. Organization Mailing Address: ______________________

   ____

4. Phone Numbers: Autovon __________ Commercial __________

5. Years of experience as an Air Force BEE ______

6. Time on station ______ years

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

SECTION - B -

ENVIRONMENTAL PROTECTION & AIR QUALITY MANAGEMENT

1. Was an Environmental Impact Statement, Environmental Assessment, FONSI, or Categorical Exclusion prepared on the current firefighter training burn facility? Circle one: YES, NO, or DON'T KNOW.

2. Does your State's Clean Air Act State Implementation Plan (SIP) specifically address firefighter training or open burning for the purposes of training firefighters? Circle: YES, NO, or DON'T KNOW.

   2.a. If YES, does the SIP Exempt, Waiver, or require a Permit for operation of the live-fire training facility? Check one:

   ______ Exempt
   ______ Waiver
   ______ Permit
   ______ None of the above
   ______ Don't know

3. Is your base located in an EPA Clean Air Act Non-Attainment Area? Check one: ___ YES ___ NO ___ DON'T KNOW.

   3a. If YES, for what pollutant(s). Check appropriate species:

   ______ Carbon Monoxide
   ______ Oxides of Nitrogen
   ______ Sulfur Oxides
   ______ Total Suspended Particulates
   ______ Non-Methane Organic Hydrocarbons
   ______ Ozone
   ______ Lead

4. Give the date of the most recent base Air Pollution Emissions Inventory (AEI):____________. Was it prepared by your office? Circle one: YES or NO.

****************** P L E A S E   N O T E ******************

If possible, please enclose a copy of the most recent Air Emissions Inventory when returning your survey response. If you elect this alternative, you can now GOTO question #12 on pg 6.

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Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

5. Are air emissions estimates from the firefighter training facility included in the inventory? Circle one: Yes or No.

6. Circle the letter corresponding to the best description of the method used to arrive at the estimates for air emissions from your firefighter training facility.

   a. USAF School of Aerospace Medicine Educational Handout, EH-114.

   b. The USAF Air Quality Assessment Model (AQAM) Emission Factors, Air Force Weapons Lab TR - 74 - 304, Feb 75.

   c. Emission Factors contained in EPA's, Compliation of Air Pollutant Emission Factors, AP-42.

   d. The State determined emission factors for fire protection training fires.

   e. The Local Pollution Regulatory Agency estimated emissions.

   f. The only State or Local regulations involve Ringleman Numbers.

   g. Our firefighter/crash-rescue training facility's air emissions have been measured & documented.

   h. Air emissions from this installation's firefighter training facility have not been estimated.

   i. Other, please describe or give reference:____________________
   ____
   ____

7. From the AEI, the annual number of training fires was: _____ per yr.

8. The quantity of fuel put in the burn-pit per fire was ________ gals.

9. If you considered evaporative losses of volatile organic hydrocarbons prior to ignition, they were estimated as (specify units, eg gallons, lbs, tons) ____________ of the original quantity of fuel given in Question #8 above.

10. If you accounted for evaporation of the unburned fuel remaining after extinguishment, give estimated quantity and units of that portion of the original quantity given in #8 above. __________.

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

11. COMPLETE THE TABLE BELOW ONLY IF YOU ARE NOT ENCLOSING A COPY OF YOUR AEI. Fill in the information as completely as possible using only your AEI and worksheets as references -- don't gather new/additional data or do any new calculations. If a listed source category does not exist on your base, enter "N/A". If a category exists on your base, but was not calculated/estimated or included in your AEI, enter "N/C".

Summary of Annual Emissions

(Specify Units: ________)

	CO	HC	NOx	PM	SOx
A. Airbase Facilities					
Training Fires					
Test Cells					
Run-Up Stands					
Power Plants					
Incinerators					
B. Evaporative/Volatile Organic Hydrocarbons					
Storage Tanks					
Filling					
Vehicle Parking					
Others (painting, etc)					
C. Ground Mobile Sources					
Military Vehicles					
Civilian Vehicles					
D. All Aircraft Sources					
E. Environs (Area Sources)					

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

12. Was the AEI presented to the Base Environmental Protection Committee? Circle one: YES, NO, or DON'T KNOW.

13. Has the AEI been provided to pollution regulatory agency officials? Circle one: YES, NO, or DON'T KNOW.
If YES, list the name of the agency ______________________________
____.

14. Is each live-fire session at the training facility coordinated with your office prior to burning? Check best estimate:

____ always (= 100%)
____ frequently (> 50%, < 100%)
____ occasionally (> 0%, < 50%)
____ never (= 0%)

15. Was your base's AEI sent to MAJCOM? ___ YES ___ NO ___ DON'T KNOW

16. Did your MAJCOM BEE review your AEI during the last Staff Assistance Visit? Check one: ___ YES ___ NO ___ DON'T KNOW

17. Did the Norton IG Team review your AEI during your last Management Inspection? ___ YES ___ NO ___ DON'T KNOW

18. Is "waste" or contaminated fuel burned at your fire training facility? Check one: ___ YES ___NO ___DON'T KNOW

If <u>NO</u> or <u>DON'T KNOW</u>, GOTO Question # 19

18a. If your base burns waste fuel for firefighter training, does your office review any laboratory analyses of the fuels to be burned at the fire training facility? Check one:

____ always (= 100%)
____ frequently (> 50%, < 100%)
____ occasionally (> 0%, < 50%)
____ never (= 0%)

+++++++++++++++++++++++ N O T E ++++++++++++++++++++++++++++++

AFR 92-1, <u>Fire Protection Training</u>, Chap 3, states:"Use aircraft, vehicular gasolines, jet fuels or other hydrocarbon fuels for training fires. Do not use fuels for training purposes that contain more than ten percent by volume of oils or lubricants. Do not use fuels for fire training purposes that contain polychlorinated biphenyls or solvents and chemicals that are defined as hazardous wastes by the US EPA's Hazardous Waste Management System Regulations (40 CFR Part 261).

+++

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

18b. If your base burns waste fuel for firefighter training, are the above guidelines from AFR 92-1, used at your base as criteria to accept or reject fuel for burning by the Fire Department? Check one: ___ YES ___ NO ___ DON'T KNOW

18c. If 18b was "NO", but some other USAF directive or criteria is being used at your base to accept or reject fuel for live-fire training burns, please describe ______________________
____
____

19. Have you observed the actual operation of your base's Firefighter Training Facility during a training session? Circle: YES or NO.

20. Have air samples been collected and analyzed during burning at your base's Firefighter Training Facility? Circle one: YES or NO. If YES, what organization performed the sampling? ____________
____
____

21. In addition to emissions estimates, have atmospheric dispersion estimates of air pollutants from your base's fire protection training area been made? Check one: ___ YES ___ NO ___ DON'T KNOW.

21a. If <u>YES</u>, briefly describe the method/technique used (ie Turner's Workbook of Atmospheric Dispersion Estimates (USEPA AP-26), AF Air Quality Assessment Model, etc) ______________________
____

22. Has your office received complaints concerning firefighter training facility operation? Circle one: YES or NO. If YES, briefly describe ______________________
____
____

23. Have Federal, State, or local pollution regulatory agency officials made inquiries concerning the Firefighter Training Facility? Check one: ___ YES ___ NO ___ DON'T KNOW.

23a. If #23 is YES, briefly give details: ______________________
____
____

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

Section - C -

EVALUATION OF MANAGEMENT ALTERNATIVES

INTRODUCTION: The remaining section seeks YOUR professional attitudes and opinions for use in evaluating feasibility and practicality of a range of possible environmental management alternatives that are designed to reduce or eliminate air emissions from USAF Firefighter Training Facilities.

24. From the list below, circle the letter(s) corresponding to the statement(s) you believe are true with respect to your installation's firefighter training facility operation.

    a. Emission of Criteria Pollutant(s) [eg Carbon Monoxide, Oxides of Nitrogen, Total Suspended Particulates, Sulfur Oxides, Organic Hydrocarbons, Ozone, and Lead] is(are) significant.

    b. Emission of Criteria Pollutant(s) is(are) insignificant.

    c. Emission of air toxics is significant. (eg NESHAP regulated species, and other toxic or carcinogenic volatile organics)

    d. Emission of air toxics is insignificant.

    e. Potential for groundwater contamination is significant.

    f. Potential for groundwater contamination is insignificant.

    g. The potential to contaminate soil and eventually groundwater is far more significant than the potential adverse air quality impact.

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

25. Complete each of the following attitudinal response items by circling the value which most closely represents YOUR OPINION concerning training effectiveness and environmental concerns with respect to USAF Firefighter Training Facilities (FFTFs).

Item	Your Attitude/Opinion: Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
a) Only fires without air pollution controls can be used to adequately train firefighters	5	4	3	2	1
b) Dense black smoke is the single most important characteristic of a training fire	5	4	3	2	1
c) Performance in real aircraft crash fires will not suffer because of training at smoke-abated FFTFs	5	4	3	2	1
d) The USAF should take positive steps to reduce air emissions from ALL FFTFs	5	4	3	2	1
e) FFTF operation & use should be more standardized & better regulated AF-wide	5	4	3	2	1
f) Current Regs are effectively limiting FFTF air emissions	5	4	3	2	1
g) More management attention to use/operation of FFTFs is needed	5	4	3	2	1
h) FFTF air emissions could be reduced by effective air quality management in lieu of installation of costly air pollution controls	5	4	3	2	1
i) The "environmental problem" associated with FFTFs is one of public relations rather than emission of hazardous levels of air pollutants	5	4	3	2	1

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

26. Drawing upon your professional experience and expertise as a USAF Bioenvironmental Engineer, evaluate each of the following air quality management alternatives as if each were being considered for implementation at your installation's Firefighter Training Facility. Rank/score each of the following air quality management alternatives by circling the appropriate number on the provided semantic differential rating scale that best indicates your opinion.

Management Alternative	Your Opinion About the Alternative				
	Practical (5)	4	Neutral (3)	2	Impractical (1)
a) Build new smoke abated FFTF	5	4	3	2	1
b) Add Air Pollution Controls to existing FFTF	5	4	3	2	1
c) Decrease quantity of fuel burned	5	4	3	2	1
d) Decrease number of training fires	5	4	3	2	1
e) Relocate facility in a remote area of the base	5	4	3	2	1
f) Send firefighters TDY to regional training center	5	4	3	2	1
g) Having your base serve as a regional training center	5	4	3	2	1
h) Stop live-fire training AF-wide	5	4	3	2	1
i) Develop training simulators to replace live-fire burn pits	5	4	3	2	1
j) Adopt meteorological go/no-go criteria to insure optimum dispersion conditions during training fires	5	4	3	2	1

k) List any of the above (or other) air quality management alternatives already implemented at your base that pertain to the operation & use of the FFTF (if none, so state): ______________________________

____

l) Comments/remarks: ______________________________

____

Appendix B.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

27. From an air pollution assimilation standpoint, could your present fire training facility be used for any other form of emergency or disaster response training conducted at your installation (eg Oil Spill or Hazardous Material Spill Response, Gas Mask Confidence, or Broken Arrow) ?

    Check one: ___ YES ___ NO ___ NO OPINION

    Remarks/comments: ____

    ____

    ____

    ____

    ____

28. Answer this question from an air pollution point of view. Could your base, with its present fire training facility, serve as the site for a Regional or MAJCOM Firefighter Training Center that would be used by several base's Fire Departments for live-fire training?

    Check one: ___ YES ___ NO ___ NO OPINION.

    Briefly state reason: ____________________________________

    ____

    ____

    ____

    ____

THANK YOU for taking the time to complete this survey and providing the requested information. Please place the completed form in the provided stamped envelope and mail as soon as possible.

Appendix B.3
Bioenvironmental Engineering Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	BEE SIP	BEE E/W/P/?	BEE CAA Non-Atn	Non-Atn NAAQS AP Specs
34809	1	6	2.5	2.5	1	5	0	n/r
54709	1	9	n/r	n/r	n/r	n/r	n/r	n/r
13805	1	5	3	3	1	3	0	n/r
15001	1	10	5	1	2	n/r	2	n/r
71009	1	8	5	2.25	1	5	0	n/r
123709	1	5	2	2	2	n/r	2	n/r
143209	1	1	1	.5	2	5	2	n/r
152509	1	8	5	1	2	5	0	n/r
164709	1	9	inexp	n/r	n/r	n/r	n/r	n/r
173509	1	7	n/r	n/r	1	2	n/r	n/r
224709	1	9	16.5	5.5	2	1	1	TSP
13309	2	6	n/r	n/r	n/r	n/r	n/r	n/r
40809	2	6	4.5	1.3	1	5	n/r	n/r
60809	2	6	n/r	n/r	n/r	n/r	n/r	n/r
34704	2	9	18	3	2	3	0	n/r
90409	2	10	1	1	2	n/r	0	n/r
101709	2	8	6	2	2	n/r	0	n/r
111909	2	2	11	1	1	1	0	n/r
132909	2	5	n/r	n/r	2	n/r	0	n/r
202209	2	1	3	3	2	n/r	2	n/r
211909	2	2	6	4	1	1	0	n/r
61602	2	5	17	3	2	5	1	TSP,Oz
242909	2	5	n/r	n/r	2	5	0	n/r
11507	3	6	1.25	1.25	2	n/r	0	n/r
23107	3	3	n/r	n/r	n/r	n/r	n/r	n/r
10904	3	4	n/r	n/r	n/r	n/r	n/r	n/r
41107	3	4	n/r	n/r	n/r	n/r	n/r	n/r
14103	3	4	n/r	n/r	n/r	n/r	n/r	n/r
54407	3	3	n/r	n/r	n/r	n/r	n/r	n/r
25001	3	10	n/r	n/r	n/r	n/r	n/r	n/r
84211	3	4	25	14	2	n/r	0	n/r
42705	3	4	n/r	n/r	n/r	n/r	n/r	n/r
62007	3	6	2	2	0	n/r	1	CO,TSP
74807	3	6	7	2.5	0	n/r	0	n/r
15105	3	4	8.5	2	2	n/r	0	n/r
80407	3	10	unk	.1	0	n/r	2	n/r
34702	3	9	19	2.5	1	1	1	N,S,Oz
23803	3	5	n/r	n/r	n/r	n/r	n/r	n/r
14610	3	8	n/r	n/r	n/r	n/r	n/r	n/r
111807	3	4	n/r	n/r	n/r	n/r	n/r	n/r
44102	3	4	2.5	2.5	0	1	0	n/r
123807	3	5	n/r	n/r	n/r	n/r	n/r	n/r
134707	3	9	2.5	2.5	2	n/r	2	n/r
43003	3	1	n/r	n/r	n/r	n/r	n/r	n/r

1=exmpt 1=yes
2=waivr 0=no
3=permt 2=dt knw
4=n/abve
5=dt knw

Appendix B.3 (cont')
Bioenvironmental Engineering Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	Date AEI	FFTF in AEI	Ref Source for EFs?	BEE Trng Fires/yr	BEE Qty gal/fire	BEE FUI, ton AP/yr	AEI to EPC	AEI to PRA	AEI to CMD
34809	1986	1	1	n/r	n/r	32.36	1	1	0
54709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13805	1985	1	n/r	6-18/wk	n/r	806.2	1	1	0
15001	1985	1	n/r	n/r	n/r	30.32	0	0	0
71009	none	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
123709	1985	1	1	34	278	30.7	0	0	0
143209	1986	1	n/r	n/r	n/r	67.91	0	2	1
152509	1986	1	1	12	800	36.58	1	0	1
164709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
173509	n/r	1	1	n/r	n/r	n/r	n/r	n/r	n/r
224709	1981	1	3	n/r	21592g/y	9.3	0	1	1
13309	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
40809	1980	0	8	36	300	23.19	1	1	2
60809	1986	1	n/r	n/r	n/r	9.48	1	0	0
34704	1985	1	2	29	600	51.57	0	1	1
90409	1983	1	n/r	n/r	n/r	40.73	2	2	2
101709	1983	1	2	n/r	10400g/yr	37.86	0	1	2
111909	1986	1	n/r	sht dwn	sht dwn	sht dwn	0	0	1
132909	none	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
202209	1985	1	2	25	500	37.05	1	0	0
211909	1984	0	n/r	n/r	n/r	n/r	2	2	1
61602	1985	0	4	24	50	4.1	0	1	0
242909	1984	1	1	n/r	n/r	81.27	1	1	1
11507	1986	0	n/r	n/r	n/r	n/r	1	2	1
23107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
10904	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
41107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14103	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
54407	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
25001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	1986	1	3	12	300	12.25	1	1	1
42705	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
62007	none	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74807	1986	1	1	n/r	7082g/y	23	1	1	1
15105	1986	1	1	24	273	22.31	1	0	1
80407	none	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34702	1986	0	8	sht dwn	sht dwn	sht dwn	0	1	1
23803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	1985	1	1	unk	5558g/y	18.88	1	1	1
123807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134707	1986	1	1	10	300	10.16	0	0	0
43003	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
		1=yes 0=no	1=EH-114 2=AFESC 3=AP-42 4=ST ------- 8=none 9=other				1=ye 0=no 2=dt	1=ye 0=no 2=dt	1=ye 0=no 2=dt

Appendix B.3 (cont')
Bioenvironmental Engineering Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	Pre-Burn Coord SGPB	Waste JP-4 Burned	Rev Lab Results	Fuel IAW AFR 92-1	Obsrvd Burn	Rcvd Cmplnts	PRAgncy Contact	Emission Contamin Opinions
34809	4	0	n/r	n/r	1	0	0	eg
54709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13805	3	1	3	1	1	1	1	ace
15001	4	1	4	2	0	0	0	bdeg
71009	3	1	4	1	0	0	0	adeg
123709	4	2	n/r	n/r	0	0	0	bdf
143209	4	2	n/r	n/r	0	0	0	bdeg
152509	4	1	4	1	1	0	0	bf
164709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
173509	4	1	4	1	0	0	n/r	n/r
224709	4	0	n/r	n/r	1	0	0	bdeg
13309	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
40809	4	0	n/r	n/r	0	1	0	eg
60809	4	1	4	2	0	0	1	a
34704	4	0	n/r	n/r	0	0	1	abdeg
90409	4	0	n/r	n/r	0	0	0	g
101709	4	1	4	1	1	0	1	eg
111909	n/r	1	4	1	0	0	1	g
132909	n/r	1	1	1	1	0	0	bdf
202209	4	1	4	2	0	0	0	aeg
211909	2	2	n/r	n/r	0	0	0	adg
61602	4	0	n/r	n/r	0	0	0	a
242909	4	1	4	2	0	0	0	dg
11507	1	1	4	2	0	0	0	bdf
23107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
10904	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
41107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14103	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
54407	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
25001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	2	1	4	1	1	0	1	g
42705	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
62007	n/r	0	n/r	n/r	0	0	1	a
74807	4	0	n/r	n/r	1	0	0	a
15105	4	1	4	2	1	0	0	deg
80407	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34702	n/r	2	n/r	n/r	0	n/r	0	acg
23803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	3	0	n/r	n/r	1	0	0	bf
123807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134707	4	1	4	1	0	0	1	bdg
43003	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
	1=alwys 2=freq 3=occas 4=never	1=yes 0=no 2=dt knw	1=alwys 2=freq 3=occas 4=never	1=yes 0=no 2=dt knw	1=yes 0=no	1=yes 0=no	1=yes 0=no	a=+NAAQS b=-NAAQS c=+toxics d=-toxics e=+gnd wt f=-gnd wt g=gndw>AP

Appendix B.3 (cont')
Bioenvironmental Engineering Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

	[ref: BEE Phase II Survey pg 9]									[ref: BEE Phase II Survey pg 10]									
Base	<--Training/Environment Concerns-->									<-----AQ Management Alternatives----->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
34809	3	2	3	2	3	2	4	4	2	1	1	4	3	2	3	2	1	1	5
54709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13805	4	2	3	4	3	2	4	4	3	1	1	4	1	1	3	5	1	2	4
15001	3	4	3	3	3	3	3	3	3	3	1	3	3	3	4	1	3	3	4
71009	2	2	4	2	4	2	4	4	2	2	1	2	2	2	2	4	1	3	5
123709	4	3	2	2	4	3	4	4	4	2	1	4	3	5	4	3	1	2	3
143209	3	2	4	2	5	3	4	3	2	1	1	4	4	4	5	1	1	4	5
152509	2	3	3	3	4	3	3	4	3	4	2	3	3	3	4	4	2	3	3
164709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
173509	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
224709	3	2	2	3	5	2	4	2	3	3	3	4	4	4	2	2	1	2	5
13309	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
40809	3	1	3	4	5	3	4	4	4	4	3	3	2	3	3	3	1	2	4
60809	3	2	3	4	4	n/r	n/r	n/r	3	4	4	n/r	3	4	4	n/r	2	n/r	4
34704	2	1	5	2	4	3	4	2	4	3	2	2	2	2	4	4	1	2	5
90409	n/r	3	2	4	5	n/r	3	3	2	n/r	n/r	2	3	n/r	2	4	1	3	4
101709	5	4	2	1	2	2	2	3	2	2	2	2	2	2	2	4	1	2	4
111909	3	2	1	2	4	1	5	4	2	1	2	2	2	4	1	3	1	4	5
132909	4	4	3	3	4	2	4	4	4	3	3	4	4	3	4	4	1	1	4
202209	3	2	2	3	4	2	4	4	3	2	3	4	4	3	4	3	2	3	4
211909	4	2	3	5	5	2	4	4	3	4	4	5	3	3	5	2	2	2	3
61602	3	4	4	4	4	3	3	3	3	3	3	4	3	4	5	4	2	3	3
242909	5	2	2	2	4	2	4	4	3	5	2	3	2	1	4	1	1	2	4
11507	2	5	2	2	3	4	2	5	3	1	3	5	5	1	1	1	1	1	4
23107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
10904	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
41107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14103	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
54407	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
25001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	3	2	4	4	4	2	5	3	2	5	1	4	3	2	3	2	1	3	5
42705	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
62007	1	1	3	3	5	3	4	3	1	3	1	3	3	3	5	5	1	1	5
74807	2	2	3	2	4	2	4	2	2	1	1	2	2	1	1	4	1	1	3
15105	4	4	2	3	2	3	4	4	4	1	1	2	2	1	1	1	1	1	4
80407	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34702	1	2	5	4	5	2	4	2	1	5	3	3	2	3	2	2	1	3	5
23803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
111807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
44102	3	3	4	4	3	3	3	4	5	3	3	4	4	3	3	4	1	2	5
123807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134707	3	2	3	4	4	3	4	3	4	4	4	3	3	1	4	1	2	3	4
43003	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r

1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

Appendix B.4
Bioenvironmental Engineering Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	BEE SIP	BEE E/W/P/?	BEE CAA Non-Atn	Non-Atn NAAQS AP Specs
10811	4	6	5.5	.6	2	n/r	2	n/r
22011	4	6	2	2	2	n/r	2	n/r
34911	4	9	5.5	1.5	1	3	1	TSP
43311	4	6	.25	.25	2	5	2	n/r
54711	4	9	n/r	n/r	2	n/r	2	n/r
14008	4	9	12	1	1	1	0	n/r
10702	4	8	6.5	3	1	3	1	Oz
104911	4	9	n/r	n/r	0	n/r	1	CO
114211	4	4	1	1	2	n/r	1	SOx
124111	4	4	1	1	2	n/r	0	n/r
133911	4	10	4	1	1	1	0	n/r
141111	4	4	6	1	1	2	0	n/r
152311	4	9	14	3	0	n/r	1	CO,TSP,O
74204	4	4	7.5	1.5	2	n/r	0	n/r
33803	4	7	n/r	n/r	n/r	n/r	n/r	n/r
161811	4	4	4	1	2	n/r	0	n/r
171111	4	4	7	1.5	2	n/r	2	n/r
35001	4	10	n/r	n/r	n/r	n/r	n/r	n/r
51502	4	6	5	1	0	n/r	1	CO
184211	4	4	n/r	n/r	n/r	n/r	n/r	n/r
232609	4	7	n/r	n/r	n/r	n/r	n/r	n/r
134905	4	9	1.5	1.5	0	n/r	1	NMHC
22705	5	5	4.5	1.5	1	1	0	n/r
62011	5	6	n/r	n/r	0	n/r	n/r	n/r
60805	5	6	2.5	2.5	2	n/r	0	n/r
90805	5	6	7.5	.5	0	n/r	0	n/r
100805	5	6	1.5	1.2	2	n/r	0	n/r
110805	5	6	.5	.5	2	n/r	2	n/r
121505	5	6	n/r	n/r	2	5	0	n/r

1=exmpt 1=yes
2=waivr 0=no
3=permt 2=dt knw
4=n/abve
5=dt knw

Appendix B.4 (cont')
Bioenvironmental Engineering Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	Date AEI	FFTF in AEI	Ref Source for EFs?	BEE Trng Fires/yr	BEE Qty gal/fire	BEE FUI, ton AP/yr	AEI to EPC	AEI to EPC	AEI to EPC
10811	1986	1	1	n/r	n/r	8.34	2	2	2
22011	1985	1	1	24	400	28.49	1	0	0
34911	1985	1	1	12	583	23.73	1	1	1
43311	1985	1	1	42	136	19.31	1	1	n/r
54711	1985	1	2	10	350	10.29	2	2	2
14008	1986	0	n/r	n/r	n/r	n/r	1	1	1
10702	1986	1	1	22	386	28.8	0	1	0
104911	1985	1	1	n/r	n/r	43.67	1	0	n/r
114211	1984	1	9	n/r	60000g/y	183	1	2	1
124111	1986	1	1	n/r	n/r	9.51	1	2	1
133911	1984	n/r	n/r	n/r	n/r	n/r	2	2	1
141111	1986	1	1	n/r	n/r	43.81	1	0	1
152311	1983	1	1	8	200	7.63	1	0	1
74204	1986	0	n/r	n/r	n/r	n/r	1	0	1
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	1986	1	1	4	500	7.23	1	0	0
171111	1984	1	1	14	150	7.2	2	2	2
35001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
51502	1985	0	8	n/r	n/r	n/r	0	1	1
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134905	1986	1	1	8	330	8.57	1	0	0
22705	1986	1	1	44	133	19.64	1	1	0
62011	1981	1	3	n/r	n/r	n/r	n/r	n/r	n/r
60805	1984	1	9	48	350	54.42	1	0	0
90805	none	1	3	11	634	23.7	n/r	n/r	n/r
100805	1985	1	1	6	415	7.3	2	2	2
110805	1986	1	1	n/r	8000g/y	4.04	1	0	0
121505	1985	0	8	n/r	n/r	n/r	2	0	1
		1=yes 0=no	1=EH-114 2=AFESC 3=AP-42 4=ST -------- 8=none 9=other				1=ye 0=no 2=dt	1=ye 0=no 2=dt	1=ye 0=no 2=dt

Appendix B.4 (cont')
Bioenvironmental Engineering Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	Pre-Burn Coord SGPB	Waste JP-4 Burned	Rev Lab Results	Fuel IAW AFR 92-1	Obsrvd Burn	Rcvd Cmplnts	PRAgncy Contact	Emission Contamin Opinions
10811	4	0	n/r	n/r	0	0	0	bd
22011	4	1	4	2	0	0	0	bdfg
34911	4	1	4	1	1	0	1	aeg
43311	4	1	2	2	0	0	0	acg
54711	4	1	4	2	0	0	0	bf
14008	1	0	n/r	n/r	0	0	0	fg
10702	4	0	n/r	n/r	1	0	1	adegg
104911	4	1	4	0	0	0	n/r	n/r
114211	4	2	n/r	n/r	0	0	0	n/r
124111	4	1	4	2	0	0	0	bdg
133911	4	0	n/r	n/r	0	0	0	bdeg
141111	4	0	n/r	n/r	0	0	0	bdf
152311	4	1	4	2	0	0	0	bf
74204	4	1	4	2	1	0	0	bdf
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	2	0	n/r	n/r	1	0	0	bg
171111	4	2	n/r	n/r	0	0	0	n/r
35001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
51502	2	0	4	n/r	0	1	1	n/r
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134905	4	0	n/r	n/r	0	0	0	ag
22705	4	1	4	2	0	0	0	bdeg
62011	4	1	0	1	1	0	n/r	n/r
60805	3	1	3	1	0	0	0	ae
90805	n/r	2	n/r	n/r	0	0	0	af
100805	4	1	1	1	0	0	0	bde
110805	3	1	4	1	0	0	1	bdg
121505	4	1	4	1	0	0	0	b
	1=alwys	1=yes	1=alwys	1=yes	1=yes	1=yes	1=yes	a=+NAAQS
	2=freq	0=no	2=freq	0=no	0=no	0=no	0=no	b=-NAAQS
	3=occas	2=dt knw	3=occas	2=dt knw				c=+toxics
	4=never		4=never					d=-toxics
								e=+gnd wt
								f=-gnd wt
								g=gndw>AP

Appendix B.4 (cont')
Bioenvironmental Engineering Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base	[ref: BEE Phase II Survey pg 9] <-Training/Environment Concerns-->									[ref: BEE Phase II Survey pg 10] <-----AQ Management Alternatives----->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
10811	3	3	2	3	3	3	3	3	4	3	4	3	3	2	2	3	2	3	5
22011	2	3	2	4	5	2	4	4	3	4	4	2	2	2	5	2	1	3	5
34911	2	2	4	3	5	2	4	3	3	4	4	2	2	2	3	3	1	1	1
43311	5	4	3	2	3	3	3	4	4	2	3	4	5	3	3	3	2	2	5
54711	1	5	3	4	4	3	4	3	3	4	1	5	5	3	5	3	3	4	3
14008	4	4	2	3	4	3	3	4	4	2	2	5	5	4	2	2	1	3	4
10702	4	4	2	2	3	4	3	1	2	2	2	2	4	1	2	1	1	2	5
104911	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
114211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
124111	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	2	2	3	4	4	2	4	4	2	1	1	4	4	3	1	1	1	3	4
141111	4	3	2	3	4	4	3	4	4	1	1	3	3	1	4	3	1	2	4
152311	3	4	4	4	4	3	4	2	5	4	4	3	1	2	1	3	1	2	4
74204	2	2	4	4	5	2	5	3	2	2	4	3	3	3	1	1	2	2	5
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	3	4	2	2	4	2	3	3	3	2	1	4	4	3	3	3	2	4	4
171111	2	1	5	4	4	2	4	3	4	4	2	5	4	5	5	3	2	3	5
35001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
51502	1	1	1	4	4	2	4	3	2	1	3	2	2	1	3	3	1	4	4
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
134905	2	5	3	4	5	2	4	3	4	4	2	4	3	2	4	3	2	4	4
22705	n/r	n/r	n/r	n/r	4	n/r	4	n/r	3	2	2	3	2	3	4	3	3	3	4
62011	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
60805	2	4	4	4	5	2	5	4	2	2	2	5	5	2	4	1	3	4	4
90805	2	1	3	4	3	3	3	3	2	2	3	3	4	5	2	1	1	1	4
100805	3	3	3	4	3	3	3	3	3	1	1	3	n/r	3	5	3	3	3	4
110805	n/r	4	2	3	4	n/r	4	4	5	1	1	3	2	4	1	2	1	2	5
121505	3	2	3	3	4	3	3	3	3	3	3	3	3	2	2	2	2	2	2

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

Appendix B.5
Bioenvironmental Engineering Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	BEE SIP	BEE E/W/P/?	BEE CAA Non-Atn	Non-Atn NAAQS AP Specs
50805	6	6	2	2	1	n/r	1	CNSPmHc
90511	7	3	n/r	n/r	1	1	0	n/r
92107	7	2	1	1	2	n/r	2	n/r
104707	7	9	n/r	n/r	n/r	n/r	n/r	n/r
24709	8	9	1	1	2	n/r	2	n/r
44204	8	4	17	1	2	n/r	2	n/r
80109	8	8	3	.1	2	n/r	0	n/r
74211	8	4	n/r	n/r	n/r	n/r	n/r	n/r
20802	8	6	18	.5	1	n/r	0	n/r
84705	8	9	2	2	2	1	1	CO.Oz
181709	8	8	5	2	2	n/r	2	n/r
192409	8	7	9	1.5	1	1	0	n/r
						1=exmpt 2=waivr 3=permt 4=n/abve 5=dt knw	1=yes 0=no 2=dt knw	

Appendix B.5 (cont')
Bioenvironmental Engineering Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	Date AEI	FFTF in AEI	Ref Source for EFs?	BEE Trng Fires/yr	BEE Qty gal/fire	BEE FUI, ton AP/yr	AEI to EPC	AEI to EPC	AEI to EPC
50805	1986	1	1	9	65	2	n/r	n/r	0
90511	1986	1	n/r	n/r	11090g/y	32.78	1	1	1
92107	1986	1	3	11	1000	32.6	1	0	0
104707	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
24709	1986	1	n/r	sht dwn	sht dwn	sht dwn	2	1	2
44204	1986	1	3	104	300	106.2	0	2	2
80109	1986	1	1	26	208	2.7	2	0	2
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	1985	0	n/r	n/r	9750g/y	31.59	1	1	1
84705	1985	1	1	120	1000	376.5	1	1	0
181709	1983	1	1	n/r	420k g/y	1424.7	1	1	2
192409	1985	0	n/r	n/r	n/r	n/r	0	1	0
		1=yes 0=no	1=EH-114 2=AFESC 3=AP-42 4=ST ------- 8=none 9=other				1=ye 0=no 2=dt	1=ye 0=no 2=dt	1=ye 0=no 2=dt

Appendix B.5 (cont')
Bioenvironmental Engineering Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	Pre-Burn Coord SGPB	Waste JP-4 Burned	Rev Lab Results	Fuel IAW AFR 92-1	Obsrvd Burn	Rcvd Cmplnts	PRAgncy Contact	Emission Contamin Opinions
50805	4	0	n/r	n/r	0	0	0	bdfg
90511	n/r	0	n/r	n/r	n/r	0	1	g
92107	n/r	0	n/r	n/r	0	0	0	acf
104707	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
24709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	eg
44204	2	1	4	2	0	0	0	bdeg
80109	4	1	4	2	0	0	0	g
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	n/r	n/r	n/r	n/r	n/r	n/r	1	n/r
84705	n/r	n/r	n/r	n/r	0	0	1	bcg
181709	1	1	4	1	0	0	0	fg
192409	4	1	4	1	0	0	0	g
	1=alwys 2=freq 3=occas 4=never	1=yes 0=no 2=dt knw	1=alwys 2=freq 3=occas 4=never	1=yes 0=no 2=dt knw	1=yes 0=no	1=yes 0=no	1=yes 0=no	a=+NAAQS b=-NAAQS c=+toxics d=-toxics e=+gnd wt f=-gnd wt g=gndw>AP

Appendix B.5 (cont')
Bioenvironmental Engineering Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base	[ref: BEE Phase II Survey pg 9] <-Training/Environment Concerns-->									[ref: BEE Phase II Survey pg 10] <-----AQ Management Alternatives----->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	j
50805	4	4	2	4	4	2	4	4	3	2	4	4	3	4	3	1	4	4	n/r
90511	2	4	4	4	2	2	3	3	4	5	5	1	1	5	3	3	1	5	5
92107	3	4	4	4	4	2	4	3	2	4	4	5	2	5	5	2	1	2	4
104707	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
24709	4	4	2	4	5	3	3	3	2	4	1	3	4	3	4	3	3	3	5
44204	2	2	4	4	4	2	4	4	2	1	4	4	4	1	1	3	1	3	5
80109	2	1	5	3	5	2	3	2	2	4	2	2	2	3	1	2	1	4	5
74211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
20802	4	4	2	3	4	3	4	3	4	n/r	n/r	n/r	n/r	n/r	5	1	2	3	5
84705	2	1	4	4	4	2	4	3	2	3	4	n/r	n/r	3	2	2	2	3	5
181709	2	3	3	4	3	4	4	4	2	4	4	5	5	5	5	5	3	4	4
192409	2	2	4	4	4	2	4	4	2	4	3	4	4	1	3	1	1	4	4

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

APPENDIX C

Appendix C.1

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

5 November 1986

Subject: Firefighter Training Facility: Air Quality Management Survey

To: Environmental Protection Officer
Civil Engineering/DEV

Bioenvironmental Engineer
USAF HOSP/SGPB

1. I need your help! Please participate in a nationwide survey of environmental management practices pertaining to USAF Firefighter Training Facilities. I am an active duty Bioenvironmental Engineer currently in an Air Force Institute of Technology PhD program. My research is being carried out in the Department of Environmental Sciences & Engineering, University of North Carolina at Chapel Hill. I have received USAF approval to administer this survey by mail (USAF SCN 86-117). Also, this management research has been coordinated with the Air Force Engineering Services Center, at Tyndall AFB, Fl. Last summer, seventy-eight Air Force Fire Departments took part in Phase I of this study which gathered facility design, use and operational data.

2. This portion of the study, Phase II, is designed to analyze USAF compliance with Federal, State and local regulatory agency requirements, and to have YOU (the cognizant experts) evaluate the feasibility/practicality of candidate air quality management alternatives. The Environmental Protection Officers and Bioenvironmental Engineers are being given different forms. Some of the questions are the same, but the two surveys are designed to focus on your primary area of responsibility. I need to hear from both of you separately!

3. It should take you about 30 minutes to complete the survey. The information requested should be in already existing documentation. It ISN'T my intent to have you prepare or generate new information. If some of the information requested is not available, or is unknown to you, please state that in the space provided. There is no need to consult regulatory agencies or other base offices regarding specific information requested. This survey is a measure of YOUR involvement with air quality/environmental management aspects related to live-fire firefighter/crash-rescue training activities. To protect confidentiality in research, your name will not be used in any reports resulting from this study, nor will your name be released to any requester.

4. Please complete at once and return it to me in the provided stamped addressed envelope by 26 Nov 86. Thank you in advance! I sincerely appreciate your help with my AFIT research. If you have any questions or would like additional information, please write, or call me at (919)+966-2677.

Respectfully,

3 atchs: 1. Survey Instructions
2. Survey Form
3. Return Envelope

Richard E. Brewer, Major, USAF BSC

Appendix C.1(cont')

ID No.   USAF SCN 86-117 (expires 31 Dec 86)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

9 December 1986

Firefighter Training Facility: Air Quality Management Survey, Second Request

Environmental Protection Officer
Civil Engineering/DEV

1. You can still help! I have received very encouraging response to the survey sent to Environmental Protection Officers (EPOs) and Bioenvironmental Engineers (BEEs) at eighty-five Air Force Bases. So far completed surveys from fifty EPOs (59%) and forty-three BEEs (51%) have been mailed back. I received your BEEs completed survey; but unfortunately, I have not gotten your response. I am sending this second request, hoping that you will please complete the previously provided green survey form and return it to me. With your assistance the accuracy of this Air Force Engineering Services Center sponsored research effort can be greatly improved.

2. Your response is very important to insure an accurate picture can be developed detailing air pollution control and environmental management aspects of firefighter training currently being conducted in the Air Force. Even if your base has suspended this training, it is still important for you to complete the entire survey form as accurately as possible (please specify that training fires have been suspended or discontinued and add a short note as to why the training has been stopped, eg groundwater contamination, IRP Phase II wells, EPA action, or State air pollution regulations/restrictions, etc).

3. Please complete the green questionnaire I sent to you in the 5 NOV 86 package and return it in the previously provided stamped envelope. If you need a new copy of the survey package please call me at 919+966-2677 or write to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

4. Thanks for your support, and I anxiously await your kind response!

Respectfully,

RICHARD E. BREWER, Major, USAF BSC

Appendix C.1(cont')

ID No. USAF SCN 86-117 (extended, expires 31 JAN 87)

THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

The School of Public Health
Department of
Environmental Sciences and Engineering

The University of North Carolina at Chapel Hill
Rosenau Hall 201 H
Chapel Hill, N.C. 27514

7 January 1987

Firefighter Training Facility: Air Quality Management Survey, Third Request

Environmental Coordinator
Civil Engineering/DEEV

1. There's a little more time! I have received a survey expiration date extension to 31 JAN 87 from HQ AFMPC for my Air Quality Management Survey. The original request and complete survey package was sent out to eighty-seven (87) Air Force Bases on 5 November.

2. I have received surveys from 67% of the contacted Environmental Protection Officers (EPOs) and 60% of the Bioenvironmental Engineers (BEEs) asked to participate in this survey. However, I still have not gotten your response. With the extension, you now have a few more days to join the other USAF Environmental Coordinators and take part in this nationwide survey. I'm sending this final request and another survey form, hoping you will find time to complete it and mail it back to me. Your response is quite important to my Air Force Institute of Technology (AFIT) doctoral research efforts here at the University of North Carolina.

3. As I mentioned in the second letter, even if your base has curtailed live-fire firefighter training, I still need to hear from you. Information about those bases where this training can't be conducted due to environmental or other constraints is most significant to my investigations. If this is the case at your base, please specify that training fires have been suspended or discontinued and provide a brief explanation why the training has been stopped, eg groundwater contamination, IRP Phase II wells, EPA action, or State air pollution regulations/restrictions, etc.

4. Please complete the enclosed green questionnaire and return it in the provided envelope. If you have any questions or need additional information, please call me at 919+966-2677 or write to me at:

Department of Environmental Sciences & Engineering
School of Public Health - 201 H
Attn: Major Richard E. Brewer
University of North Carolina
Chapel Hill, North Carolina 27514

Respectfully,

3 atchs: 1. Instructions
2. Green survey form
3. Return envelope

RICHARD E. BREWER, Major, USAF BSC

Appendix C.2

SURVEY INSTRUCTIONS

1. This is a nationwide survey of environmental air quality management aspects of conducting live-fire training for USAF firefighters and crash-rescue personnel. Completion of the survey should take about 30 minutes of your time. Participation is voluntary and your identity will not be used in any reports or publications resulting from this research.

2. Please complete the survey form as completely as possible. If additional space is needed for you to answer the few responses requesting descriptions, please use the back of the survey or attach additional paper indicating the applicable question number.

3. This is a questionnaire about your involvement in air quality management aspects of your base's firefighter training facility/program and you are not being asked to research answers outside your office for any questions you do not know the answer to. Both the Bioenvironmental Engineer and the Environmental Protection Officer from eighty-seven (87) bases are being asked to participate. If you do not know the answer to any of the questions please indicate where appropriate.

4. After completing the survey form, place it and any additional paper used to answer description questions, in the stamped envelope provided and mail at once! THANK YOU!!

Richard E. Brewer, Major, USAF BSC
Department of Environmental Sciences & Engineering
School of Public Health - 201 H
University of North Carolina
Chapel Hill, North Carolina 27514
919+966-2677

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

ENVIRONMENTAL AIR QUALITY MANAGEMENT ALTERNATIVES: USAF FIREFIGHTER/CRASH-RESCUE TRAINING FACILITIES

ENVIRONMENTAL MANAGEMENT QUESTIONNAIRE

for

USAF ENVIRONMENTAL PROTECTION OFFICERS

****

PRIVACY ACT STATEMENT

The information gathered in this survey is subject to the Privacy Act of 1974. Authority: 10 USC 8012; 44 USC 3101; Executive Order 9397. Principal purpose: to collect data about the environmental management of US Air Force Firefighter/Crash-Rescue Training Facilities. Routine use: develop and evaluate environmental air quality management alternatives to reduce or eliminate air emissions resulting from live-fire training programs. Disclosure is voluntary; however, since Firefighter Training and Environmental Management Programs differ from base-to-base, between MAJCOMs, and between States or Air Quality Regions, the importance of your responses cannot be overemphasized! Without your participation the accuracy of the study would be decreased and possibly lead to erroneous conclusions and inappropriate recommendations of future air quality management alternatives.

****

To further protect confidentiality in research, names of respondents will NOT be released or used in any publications associated with this research. Additionally, specific Air Force Bases, MAJCOMs, States, and EPA Air Quality Control Regions will NOT be revealed; rather, each base has been assigned an identification number. Your Base's ID # appears in the upper lefthand corner of each survey sheet.

This research is being conducted in the Department of Environmental Sciences & Engineering, School of Public Health, at the University of North Carolina at Chapel Hill. The work is sponsored by and has been coordinated with the Air Force Engineering Services Center, Tyndall AFB, FL.

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

SECTION - A -

Respondent Identification & General Information

```
**********************************************************************
*                                                                    *
*   Completion of Section A is voluntary. Your name,                *
*   mailing address, and phone number will ONLY be used to          *
*   contact you for possible follow-up information or               *
*   clarification of responses. YOUR name will NOT appear           *
*   in any published project documents NOR be released to          *
*   any requester.                                                   *
*                                                                    *
**********************************************************************
```

1. Name: ______________________________

2. Duty Title: ______________________________

3. Organization Mailing Address: ______________________________

____

4. Phone Numbers: Autovon ______________ Commercial ______________

5. Years experience as an AF Environmental Protection Officer ________

6. Time on station ________ years

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

SECTION - B -

ENVIRONMENTAL PROTECTION & AIR QUALITY MANAGEMENT

1. Was an Environmental Impact Statement, Environmental Assessment, FONSI, or Categorical Exclusion prepared on the current firefighter training burn facility? Circle one: YES, NO, or DON'T KNOW.

2. Has your MAJCOM issued supplemental environmental protection guidance pertaining to firefighter training facilities? Circle: Yes or No. If YES, identify (eg MAJCOM Supplement to AFR XX-XX, Command Policy Letter, etc) ______________________________
____
____

3. Does your installation have local written environmental protection procedures or written policy concerning the firefighter training facility? Check: ___Yes, ___No, ___ Don't Know. If YES, briefly describe: ______________________________
____
____

4. Is each live-fire session at the training facility coordinated with your office prior to burning? Check best estimate:

   _____ always (= 100%)
   _____ frequently (> 50%, < 100%)
   _____ occasionally (> 0%, < 50%)
   _____ never (= 0%)

5. Is each live-fire training session coordinated with local pollution control agencies prior to burning? Check one:

   _____ always (= 100%)
   _____ frequently (> 50%, < 100%)
   _____ occasionally (> 0%, < 50%)
   _____ never (= 0%)
   _____ don't know

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

6. Has your office received complaints concerning firefighter training facility operation? Circle one: YES or NO.
   If YES, briefly describe______________________________________
   ____
   ____

7. Has your base submitted a Project Plan Booklet for a new Firefighter/Crash-Rescue Training Facility? Circle one: YES or NO

   If NO, GOTO Question #8

   7a. If #7 is YES, has the project been approved at MAJCOM? Circle one: YES, NO, or DON'T KNOW

   7b. If #7 is YES, was the project funded ? Circle: YES or NO. If YES, for what fiscal year? _____

   7c. What are the estimated construction and O&M costs for the new facility?

   Construction $________
   O&M $________ per yr

   7d. Were the AFM 88-15 standard drawings for Firefighter Training Facilities used to design the planned new facility? Check one: ___ YES, ___ NO, ___ DON'T KNOW.

   7e. If 7d is NO, give source/reference for facility design/drawings (eg MAJCOM, AFESC) ltr/date ___________________________
   ____

   7f. Briefly describe the expected air quality impacts set forth in the Project Plan Booklet: ___________________________
   ____
   ____
   ____

8. What were(are) the costs for the present Firefighter Training Facility?

   Construction $________
   O&M $________ per yr.

   8a. What was the source of the design for the cuurent fire training facility? ____
   ____

   8b. List ALL improvements made in the last 15 years that were designed to control or decrease the potential for adverse environmental impact from training fires. ________________
   ____
   ____

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

9. Is "waste" or contaminated fuel burned at your fire training facility?
Check one: ___ YES ___ NO ___ DON'T KNOW

If NO or DON'T KNOW, GOTO Question # 10

```
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
+ AFR 92-1, Fire Protection Training, Chap 3, states: +
+ "Use aircraft, vehicular gasolines, jet fuels or    +
+ other hydrocarbon fuels for training fires. Do not  +
+ use fuels for training purposes that contain more   +
+ than ten percent by volume of oils or lubricants.   +
+ Do not use fuels for fire training purposes that    +
+ contain polychlorinated biphenyls or solvents and   +
+ chemicals that are defined as hazardous wastes by   +
+ the US EPA's Hazardous Waste Management System      +
+ Regulations (40 CFR Part 261).                      +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

9a. If your base burns waste fuel for firefighter training, are the above guidelines from AFR 92-1, used at your base as criteria to accept or reject fuel for burning by the Fire Department? Check one: ___ YES ___ NO ___ DON'T KNOW

9b. If 9a was "NO", but some other USAF directive or criteria is being used at your base to accept or reject fuel for live-fire training burns, please describe ______________________
____
____

10. Have you observed the actual operation of your base's Firefighter Training Facility during a training session? Circle: YES or NO.

11. Have Federal, State, or local pollution regulatory agency officials made inquiries concerning the Firefighter Training Facility? Check one: ___ YES ___ NO ___ DON'T KNOW.

11a. If #11 is YES, briefly give details: ______________________
____
____

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

Section - C -

EVALUATION OF MANAGEMENT ALTERNATIVES

INTRODUCTION: The remaining section seeks YOUR professional attitudes and opinions for use in evaluating feasibility and practicality of a range of possible environmental management alternatives that are designed to reduce or eliminate air emissions from USAF Firefighter Training Facilities.

12. From the list below, circle the letter(s) corresponding to the statement(s) you believe is(are) true with respect to your installation's firefighter training facility operation.

    a. Emission of Criteria Pollutant(s) [eg Carbon Monoxide, Oxides of Nitrogen, Total Suspended Particulates, Sulfur Oxides, Organic Hydrocarbons, Ozone, and Lead] is(are) significant.

    b. Emission of Criteria Pollutant(s) is(are) insignificant.

    c. Emission of air toxics is significant. (eg NESHAP regulated species, and other toxic or carcinogenic volatile organics)

    d. Emission of air toxics is insignificant.

    e. Potential for groundwater contamination is significant.

    f. Potential for groundwater contamination is insignificant.

    g. The potential to contaminate soil and eventually groundwater is far more significant than the potential adverse air quality impact.

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

13. Complete each of the following attitudinal response items by circling the value which most closely represents YOUR OPINION concerning training effectiveness and environmental concerns with respect to USAF Firefighter Training Facilities (FFTFs).

Item	Your Attitude/Opinion: Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
a) Only fires without air pollution controls can be used to adequately train firefighters	5	4	3	2	1
b) Dense black smoke is the single most important characteristic of a training fire	5	4	3	2	1
c) Performance in real aircraft crash fires will not suffer because of training at smoke-abated FFTFs	5	4	3	2	1
d) The USAF should take positive steps to reduce air emissions from ALL FFTFs	5	4	3	2	1
e) FFTF operation & use should be more standardized & better regulated AF-wide	5	4	3	2	1
f) Current Regs are effectively limiting FFTF air emissions	5	4	3	2	1
g) More management attention to use/operation of FFTFs is needed	5	4	3	2	1
h) FFTF air emissions could be reduced by effective air quality management in lieu of installation of costly air pollution controls	5	4	3	2	1
i) The "environmental problem" associated with FFTFs is one of public relations rather than emission of hazardous levels of air pollutants	5	4	3	2	1

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

14. Drawing upon your professional experience and expertise as a USAF Environmental Protection Officer, evaluate each of the following air quality management alternatives as if each were being considered for implementation at your installation's Firefighter Training Facility. Rank/score each of the following air quality management alternatives by circling the appropriate number on the provided semantic differential rating scale that best indicates your opinion.

Management Alternative	Your Opinion About the Alternative				
	Practical (5)	4	Neutral (3)	2	Impractical (1)
a) Build new smoke abated FFTF	5	4	3	2	1
b) Add Air Pollution Controls to existing FFTF	5	4	3	2	1
c) Decrease quantity of fuel burned	5	4	3	2	1
d) Decrease number of training fires	5	4	3	2	1
e) Relocate facility in a remote area of the base	5	4	3	2	1
f) Send firefighters TDY to regional training center	5	4	3	2	1
g) Having your base serve as a regional training center	5	4	3	2	1
h) Stop live-fire training AF-wide	5	4	3	2	1
i) Develop training simulators to replace live-fire burn pits	5	4	3	2	1
j) Adopt meteorological go/no-go criteria to insure optimum dispersion conditions during training fires	5	4	3	2	1

k) List any of the above (or other) air quality management alternatives already implemented at your base that pertain to the operation & use of the FFTF (if none, so state): ______________________________

____

l) Comments/remarks: ______________________________

____

Appendix C.2(cont')

ID No. USAF SCN 86-117 (expires 31 DEC 86)

15. From an environmental protection standpoint, could your present fire training facility be used for any other form of emergency or disaster response training conducted at your installation (eg Oil Spill, Hazardous Material Spill Response, Gas Mask Confidence, or Broken Arrow) ?

Check one: ___ YES ___ NO ___ NO OPINION

Remarks/comments: ____

____

____

____

____

16. Answer this question from an environmental protection/management point of view. Could your base, with its present fire training facility, serve as the site for a Regional or MAJCOM Firefighter Training Center that would be used by several base's Fire Departments for live-fire training?

Check one: ___ YES ___ NO ___ NO OPINION.

Briefly state reason: ____

____

____

____

THANK YOU for taking the time to complete this survey and providing the requested information. Please place the completed form in the provided stamped envelope and mail as soon as possible.

Appendix C.3
Environmental Protection Officer Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	Written MAJCOM Policy	Written Local Guidlns	Pre-Burn Coord DEEV	Pre-Burn PRAgncy Coord	Rcvd Complnts	PRAgncy Inquiry
34809	1	6	2.5	2.5	1	0	4	4	0	0
54709	1	9	n/r	n/r	0	0	4	4	1	1
13805	1	5	8	3	1	1	n/r	n/r	0	1
15001	1	10	1.5	1	0	0	4	1	0	0
71009	1	8	.3	.3	0	2	4	5	0	0
123709	1	5	n/r	n/r	1	0	2	1	0	0
143209	1	1	n/r	n/r	n/r	0	4	4	0	0
152509	1	8	10	20	1	1	1	1	1	1
164709	1	9	1	3	1	0	4	1	0	1
173509	1	7	5	16	1	1	4	5	0	2
224709	1	9	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13309	2	6	n/r	n/r	0	0	3	3	0	0
40809	2	6	.3	.3	0	1	3	1	1	1
60809	2	6	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34704	2	9	1	1	0	0	4	4	1	1
90409	2	10	4	8.5	0	2	4	1	0	0
101709	2	8	n/r	n/r	2	0	4	4	0	1
111909	2	2	n/r	n/r	0	0	4	4	0	0
132909	2	5	15	19	1	0	4	1	0	2
202209	2	1	.5	6	n/r	2	4	5	0	2
211909	2	2	.5	.5	1	0	4	5	0	2
61602	2	5	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
242909	2	5	8	8	1	0	4	1	0	0
11507	3	6	1	20	1	2	4	5	0	0
23107	3	3	2	2	0	0	4	3	0	1
10904	3	4	.3	8	0	0	4	4	0	0
41107	3	4	n/r	n/r	0	0	3	3	1	1
14103	3	4	2	3	0	1	3	1	0	0
54407	3	3	10	19	0	0	1	1	0	0
25001	3	10	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	3	4	1	1	0	2	4	1	0	0
42705	3	4	1	1	1	1	1	4	0	1
62007	3	6	n/r	n/r	0	1	4	4	1	1
74807	3	6	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15105	3	4	1	1	0	0	4	4	0	0
80407	3	10	n/r	n/r	n/r	1	4	1	0	2
34702	3	9	19	2.5	0	0	n/r	n/r	n/r	n/r
23803	3	5	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	3	8	5	3	0	1	4	1	0	0
111807	3	4	2	2	0		3	1	0	0
44102	3	4	1.5	3	0	2	4	4	0	0
123807	3	5	1.5	3.5	1	1	3	4	0	1
134707	3	9	3	3	0	0	4	4	1	1
43003	3	1	5	5	0	1	1	5	0	1
					1=yes 0=no	1=yes 0=no 2=dt knw	1=always 2=freq 3=occas 4=never	1=always 2=freq 3=occas 4=never 5=dt knw	1=yes 0=no	1=yes 0=no 2=dt knw

Appendix C.3 (cont')
Environmental Protection Officer Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base ID #	Plan For New FFTF New FFTF?	Design Source	EIS/A FONSI	Current FFTF Design	Waste JP-4 Burned	Fuel IAW AFR 92-1	Obsrvd Training Fire	Emission Contamin Opinions
34809	0	n/r	2	2	1	n/r	0	adeg
54709	0	n/r	0	n/r	0	n/r	1	n/r
13805	1	4	n/r	5	1	1	1	bdf
15001	0	n/r	2	2	1	n/r	0	bdeg
71009	0	1	2	2	1	1	0	bdf
123709	0	n/r	2	3	0	n/r	1	df
143209	0	n/r	2	2	0	n/r	0	bdf
152509	1	1	0	2	0	n/r	1	ag
164709	0	n/r	1	n/r	0	1	0	aceg
173509	0	n/r	1	2	1	1	0	bcdf
224709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13309	0	n/r	1	3	1	1	1	bdeg
40809	0	n/r	0	2	1	1	1	bdf
60809	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34704	0	n/r	0	n/r	1	1	0	bdeg
90409	0	n/r	1	3	1	1	0	bdg
101709	1	AFESC	0	5	1	0	11	g
111909	0	n/r	1	2	1	1	1	acf
132909	0	n/r	1	2	1	1	1	abdfg
202209	0	n/r	2	n/r	0	n/r	0	n/r
211909	0	n/r	1	5	1	1	1	aceg
61602	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
242909	0	n/r	0	6	0	n/r	1	g
11507	0	n/r	2	3	1	1	0	b
23107	1	AFESC	2	2	1	1	1	eg
10904	0	n/r	0	n/r	2	n/r	0	ace
41107	0	n/r	1	6	0	n/r	1	bdf
14103	1	n/r	0	n/r	1	1	0	deg
54407	0	n/r	0	2	1	1	1	eg
25001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	0	n/r	1	n/r	1	2	0	b
42705	0	n/r	1	3	1	1	1	bf
62007	1	4	0	2	0	n/r	1	aceg
74807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15105	0	n/r	n/r	n/r	1	n/r	1	aeg
80407	1	5	2	5	1	2	0	adeg
34702	1	n/r	2	n/r	n/r	n/r	n/r	aceg
23803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	0	n/r	0	5	1	1	1	bf
111807	0	1	0	2	0	1	0	g
44102	0	n/r	2	5	0	n/r	0	be
123807	0	n/r	2	2	1	1	1	n/r
134707	1	n/r	0	5	0	2	0	bdeg
43003	0	n/r	1	4	0	n/r	0	bdf
	1=yes 0=no	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw	1=yes 0=no 2=dtknw	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw 6=other	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=yes 0=no	a=+NAAQS b=-NAAQS c=+Toxics d=-Toxics e=+gnd wt f=-gnd wt g=gdwt>AP

Appendix C.3 (cont')
Environmental Protection Officer Data
Study Category A
Mockup Classes 1,2,3
Bomber, Tanker, Transport

Base	[Ref: EPO Phase II Survey pg 7] <--Training/Environment Concerns-->									[Ref: EPO Phase II Survey pg 8] <-----AQ Management Alternatives---->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	J
34809	3	3	3	3	4	2	4	2	2	2	2	3	3	3	2	3	2	2	3
54709	2	3	5	5	5	3	5	3	3	4	1	4	4	5	2	1	1	3	5
13805	3	3	4	4	4	3	3	2	3	4	2	2	2	2	1	1	1	1	1
15001	5	2	2	3	5	3	4	4	2	2	3	5	5	5	4	2	1	2	5
71009	3	4	2	3	4	3	3	3	3	3	3	3	3	2	3	3	2	4	4
123709	5	5	1	1	1	4	3	4	5	1	1	5	3	5	5	1	1	1	3
143209	3	3	2	2	4	3	4	3	4	1	1	3	3	1	2	2	2	2	3
152509	4	3	2	3	4	2	4	4	4	3	3	4	4	4	2	4	2	2	4
164709	2	2	4	4	5	2	4	2	2	4	n/r	3	3	1	1	1	1	3	5
173509	4	4	2	3	5	3	3	3	4	1	2	3	2	1	1	1	1	1	4
224709	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
13309	4	5	4	4	4	3	2	4	3	2	2	3	4	3	2	2	1	2	3
40809	4	2	4	3	2	4	2	3	3	2	2	4	2	2	2	2	1	2	2
60809	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
34704	4	2	4	2	4	2	4	4	4	2	2	5	5	5	5	4	1	1	4
90409	2	2	3	4	3	3	3	2	2	2	4	3	3	1	1	1	1	3	5
101709	2	2	4	2	5	2	4	3	4	4	3	4	2	3	1	3	1	2	5
111909	3	2	1	4	5	2	4	3	1	3	4	1	1	3	3	5	1	4	5
132909	5	5	1	4	4	3	3	2	4	3	4	4	4	5	3	3	3	3	5
202209	4	5	3	5	2	2	3	4	5	3	4	4	4	2	2	3	2	3	4
211909	3	5	2	3	3	3	4	3	3	3	3	4	3	3	2	2	1	2	3
61602	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
242909	2	1	4	3	4	3	2	3	4	5	2	3	2	5	5	3	1	3	3
11507	2	2	4	5	5	3	4	4	4	3	3	2	2	2	2	2	2	3	3
23107	4	2	4	4	4	1	4	2	4	2	2	2	2	4	1	4	1	3	5
10904	3	1	1	1	5	3	4	4	2	4	3	3	2	4	3	4	1	4	4
41107	2	1	4	4	5	2	4	2	2	1	2	3	2	1	3	3	1	3	5
14103	3	2	2	4	4	2	4	2	3	4	2	2	1	1	4	1	1	3	5
54407	4	3	2	2	4	2	4	4	4	3	2	4	2	3	5	2	1	4	5
25001	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
84211	3	3	3	4	2	3	4	3	2	2	2	2	2	1	1	1	1	4	4
42705	2	2	5	4	4	2	4	4	2	3	4	4	4	5	5	1	1	5	5
62007	5	1	1	2	2	4	4	5	4	2	2	1	2	1	1	5	1	1	5
74807	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
15105	5	1	4	5	5	2		1	1	2	2	5	1	2	4	2	1	3	5
80407	3	2	3	4	3	3	3	4	3	4	4	3	2	3	2	3	1	2	3
34702	1	1	5	4	5	2	4	2	1	5	3	3	2	3	2	2	1	3	5
23803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14610	2	4	4	4	3	3	4	3	4	5	1	3	4	3	5	1	1	5	5
111807	3	5	2	4	5	4	3	4	4	4	4	5	1	1	2	3	1	1	2
44102	4	2	2	3	3	3	4	3	3	4	2	2	2	2	4	4	2	2	3
123807	3	4	3	3	5	3	4	4	4	2	2	4	3	5	4	3	2	4	4
134707	2	4	2	2	5	2	4	4	2	2	2	4	4	4	2	1	2	2	5
43003	2	2	4	5	4	4	3	2	3	4	4	4	2	3	3	3	5	2	4

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

Appendix C.4
Environmental Protection Officer Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	Written MAJCOM Policy	Written Local Guidlns	Pre-Burn Coord DEEV	Pre-Burn PRAgncy Coord	Rcvd Complnts	PRAgncy Inquiry
10811	4	6	n/r	10	2	2	4	5	0	0
22011	4	6	6	6	1	0	4	4	0	0
34911	4	9	6	6	0	1	1	1	0	1
43311	4	6	1.5	1.5	0	1	3	1	0	1
54711	4	9	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14008	4	9	2.5	2.5	0	2	4	4	0	0
10702	4	8	4	4	0	2	4	5	0	0
104911	4	9	7	5	1	0	4	1	0	1
114211	4	4	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
124111	4	4	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	4	10	3	3	0	0	4	4	0	1
141111	4	4	n/r	n/r	1	0	4	1	0	0
152311	4	9	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74204	4	4	3	3	0	2	4	5	0	0
33803	4	7	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	4	4	n/r	n/r	0	0	2	2	0	1
171111	4	4	6	6	0	0	2	4	0	1
35001	4	10	n/r	n/r	0	2	4	n/r	0	0
51502	4	6	5	1	n/r	n/r	n/r	n/r	1	1
184211	4	4	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	4	7	1	1	0	0	4	4	0	1
134905	4	9	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
22705	5	4	10	10	1	1	4	1	0	1
62011	5	6	2	.6	1	1	3	1	0	1
60805	5	6	n/r	n/r	n/r	2	3	5	0	0
90805	5	6	12	4	0	1	1	1	0	1
100805	5	6	14	3	0	0	4	4	0	0
110805	5	6	1.5	1.5	0	1	4	5	0	1
121505	5	6	9	9	0	0	1	1	0	0
					1=yes 0=no	1=yes 0=no 2=dt knw	1=always 2=freq 3=occas 4=never	1=always 2=freq 3=occas 4=never 5=dt knw	1=yes 0=no	1=yes 0=no 2=dt knw

Appendix C.4 (cont')
Environmental Protection Officer Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

Base ID #	Plan For New FFTF?	New FFTF Design Source	EIS/A FONSI	Current FFTF Design	Waste JP-4 Burned	Fuel IAW AFR 92-1	Obsrvd Training Fire	Emission Contamin Opinions
10811	0	n/r	0	2	0	n/r	1	g
22011	1	1	0	2	1	1	0	bdfg
34911	1	4	0	5	1	1	1	adeg
43311	1	4	1	n/r	0	1	1	adf
54711	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14008	0	n/r	1	n/r	n/r	1	0	g
10702	0	n/r	0	5	0	n/r	0	bf
104911	1	5	0	2	1	1	0	eg
114211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
124111	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	0	n/r	0	2	1	1	1	dfg
141111	0	n/r	0	n/r	0	n/r	0	bdef
152311	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74204	0	n/r	1	2	1	1	0	adf
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	0	n/r	1	3	1	1	1	dfg
171111	0	n/r	0	2	0	n/r	0	eg
35001	0	n/r	2	n/r	1	2	0	bdf
51502	n/r	n/r	0	n/r	0	n/r	0	n/r
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	1	1	2	n/r	0	n/r	0	bdeg
134905	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
-----	--------	--------	------	--------	--------	--------	--------	--------
22705	1	3	1	3	1	1	1	beg
62011	0	n/r	n/r	2	1	1	1	eg
60805	0	n/r	2	n/r	1	1	0	bdf
90805	1	5	2	n/r	0	n/r	0	bdfg
100805	0	n/r	2	5	1	1	0	adef
110805	2	n/r	0	5	1	1	0	n/r
121505	0	n/r	0	3	1	1	0	bdf
	1=yes 0=no	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw	1=yes 0=no 2=dtknw	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw 6=other	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=yes 0=no	a=+NAAQS b=-NAAQS c=+Toxics d=-Toxics e=+gnd wt f=-gnd wt g=gdwt>AP

Appendix C.4 (cont')
Environmental Protection Officer Data
Study Category B
Mockup Classes 4,5
Fighter, Trainer

	[Ref: EPO Phase II Survey pg 7]									[Ref: EPO Phase II Survey pg 8]									
Base	<--Training/Environment Concerns-->									<-----AQ Management Alternatives---->									
ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	J
10811	2	4	2	2	3	4	2	4	4	2	2	2	2	2	2	2	1	1	4
22011	2	2	4	2	4	4	4	4	2	3	2	4	1	3	1	3	1	3	4
34911	4	2	2	5	5	2	4	4	2	2	5	4	4	1	3	1	1	1	5
43311	3	1	5	4	4	2	3	2	2	3	2	4	4	3	3	3	1	2	4
54711	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
14008	2	2	4	4	4	2	4	3	3	5	1	3	3	3	2	2	1	4	5
10702	1	3	3	2	3	3	3	3	4	3	3	4	3	3	2	3	2	3	4
104911	5	3	n/r	3	1	4	3	3	2	n/r	n/r	2	2	4	1	3	1	2	5
114211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
124111	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
133911	4	2	5	4	5	3	5	5	3	2	1	4	3	3	4	3	1	5	1
141111	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
152311	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74204	2	5	3	2	3	3	4	4	2	1	2	2	2	1	1	1	2	3	5
33803	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
161811	4	3	2	2	4	3	2	4	2	2	2	2	3	2	1	1	1	2	4
171111	2	3	2	4	5	4	5	3	1	4	2	3	2	4	3	3	1	2	4
35001	5	3	2	2	2	3	3	4	4	1	1	2	2	5	1	4	1	1	4
51502	1	1	1	4	4	2	4	3	2	1	3	2	2	1	3	3	1	4	4
184211	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
232609	3	2	2	4	5	3	5	4	2	1	1	4	3	1	2	2	1	4	5
134905	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
22705	4	2	2	4	3	4	2	2	3	4	4	1	1	2	1	4	1	3	5
62011	2	2	4	4	5	1	5	3	2	5	1	1	1	4	1	3	1	1	3
60805	3	2	2	2	3	4	1	4	4	2	3	3	2	4	4	5	1	2	3
90805	5	4	1	1	3	5	5	5	1	1	1	3	1	5	1	4	1	1	5
100805	3	3	3	3	5	1	5	3	1	3	3	3	3	1	5	5	1	3	5
110805	4	1	2	4	4	2	4	4	2	2	2	4	2	2	2	2	2	2	4
121505	3	4	3	3	4	3	2	3	4	2	2	2	2	2	3	2	2	4	4

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

Appendix C.5
Environmental Protection Officer Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	CLS	EPA/ FEMA Rgn	Yrs Exprnc	TOStn, yrs	Written MAJCOM Policy	Written Local Guidlns	Pre-Burn Coord DEEV	Pre-Burn PRAgncy Coord	Rcvd Complnts	PRAgncy Inquiry
50805	6	6	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
90511	7	3	5	5	1	1	3	3	0	0
92107	7	2	10	18	n/r	n/r	n/r	n/r	n/r	n/r
104707	7	9	n/r	n/r	0	2	4	1	0	2
24709	8	9	4.5	2	1	0	4	1	0	1
44204	8	4	25	14	n/r	n/r	2	n/r	0	1
80109	8	8	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	8	4	15	10	2	2	4	1	0	1
20802	8	6	n/r	n/r	0	1	1	1	0	1
84705	8	9	5	34	0	0	4	1	1	1
181709	8	8	5	20	2	2	4	4	0	1
192409	8	7	n/r	n/r	0	2	4	4	0	1
					1=yes 0=no	1=yes 0=no 2=dt knw	1=always 2=freq 3=occas 4=never	1=always 2=freq 3=occas 4=never 5=dt knw	1=yes 0=no	1=yes 0=no 2=dt knw

Appendix C.5 (cont')
Environmental Protection Officer Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

Base ID #	Plan For New FFTF?	New FFTF Design Source	EIS/A FONSI	Current FFTF Design	Waste JP-4 Burned	Fuel IAW AFR 92-1	Obsrvd Training Fire	Emission Contamin Opinions
50805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
90511	1	5	1	3	0	n/r	0	eg
92107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
104707	0	n/r	1	1	2	1	0	de
24709	0	n/r	0	3	1	1	0	bg
44204	n/r	n/r	0	n/r	1	1	1	g
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	0	n/r	0	2	1	1	1	adeg
20802	1	1	1	n/r	1	1	0	beg
54705	0	n/r	1	3	1	1	1	aeg
181709	0	n/r	2	2	1	1	1	bdf
192409	0	n/r	2	n/r	1	1	0	ae
	1=yes 0=no	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw	1=yes 0=no 2=dtknw	1=M88-15 2=InHouse 3=MAJCOM 4=AFESC 5=dt knw 6=other	1=yes 0=no 2=dt knw	1=yes 0=no 2=dt knw	1=yes 0=no	a=+NAAQS b=-NAAQS c=+Toxics d=-Toxics e=+gnd wt f=-gnd wt g=gdwt>AP

Appendix C.5 (cont')
Environmental Protection Officer Data
Study Category C
Mockup Classes 6,7,8
Rotary Wing, No Mockup, Unknown

	[Ref: EPO Phase II Survey pg 7] <--Training/Environment Concerns-->									[Ref: EPO Phase II Survey pg 8] <-----AQ Management Alternatives---->									
Base ID #	a	b	c	d	e	f	g	h	i	a	b	c	d	e	f	g	h	i	J
50805	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
90511	3	2	2	4	4	2	4	4	2	4	3	4	3	5	5	3	2	2	5
92107	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
104707	5	2	2	4	2	3	4	4	4	2	3	4	4	5	5	4	1	2	5
24709	2	2	3	3	4	3	5	4	1	2	2	3	2	4	4	5	1	4	2
44204	3	2	4	4	4	2	5	3	2	5	1	4	3	2	3	2	1	3	5
80109	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
74211	4	1	2	4	5	2	4	4	4	4	1	1	1	5	1	5	1	1	4
20802	5	2	2	1	1	4	2	4	4	4	3	4	4	4	1	1	1	1	3
84705	3	2	3	3	5	2	4	4	3	3	3	4	3	3	2	3	3	3	4
181709	2	4	4	2	3	3	3	4	4	1	1	3	3	1	1	1	1	1	1
192409	3	3	3	3	3	3	3	3	1	5	1	3	3	1	4	3	1	2	5

Training/Environment Concerns	AQ Management Alternatives
1 = Strongly Disagree	1 = Impractical
2 = Disagree	
3 = Neutral	3 = Neutral
4 = Agree	
5 = Strongly Agree	5 = Practical

APPENDIX D

Table D.1

Phase I
USAF Firefighter Training Facility
Design Characteristics

Characteristic	Total	%
Number of smoke abated training facilities	9/78	11.5%
Concrete pad lined the burn surface	19/74	25.7%
Qty fuel put in training pit was measured	50/74	67.6%
Oil/water separator for pit effluent	30/72	41.7%
Underground fuel dispensing system	64/74	86.5%

Characteristic	Minimum	Maximum	Mean	Stnd Dev
Year facility put into use	1940	1987	1973	11.6
Diameter fuel pool, ft	20	600	101	79.5
Distance to base boundary, mi	0	8	0.7	1.1
Closest off-base area/bldg, mi	0.06	30	2.9	4.1
Closest on-base area/bldg, mi	0.04	2	0.5	0.5

Table D.2

Phase I
USAF Firefighter Training Facility
Use Information

Parameter	Total	%
Facility is shut down for health, safety, or envr	9/77	11.7%
Provide training for other military bases	22/75	29.3%
Provide training for civilian fire departments	35/75	46.7%
Usual time of day for training fire	a.m. 45 p.m. 29	60.8% 39.2%

Parameter	Minimum	Maximum	Mean	Stnd Dev
Number training fires conducted per year	4	134	25.8	19.2
Gallons of JP-4 burned per trng fire	100	2000	502.2	343.2
Number of firefighters in base fire department	48	143	72.6	20.0
Number of times each firefighter is trained/yr	2	28	5.4	4.3

Table D.3

Phase I
USAF Firefighter Training Facility
Operational Information

Parameter	Total	%
Burn waste JP-4 for firefighter training	40/74	54.0%
Lab tests waste JP-4 before burning	27/57	47.4%
Residual fuel is left in basin after training	37/72	51.4%

Parameter	Minimum	Maximum	Mean	Stnd Dev
Time needed to extinguish trng fire, minutes	0.3	5	1.7	1.0
Number of times same fuel pool is re-ignited	0	10	1.2	

Table D.4

Environmental Protection Officer
Regulatory Awareness & Activities

Question	YES	NO	DIDN'T KNOW
Was environmental impact document prepared	21/67 31.3%	27/67 40.3%	19/67 28.4%
Has request been submitted for a new facility	18/67 26.9%	48/67 71.6%	1/67 1.5%
Has PRAgncy made inquiries about training fires	33/62 53.2%	29/62 46.8%	

Table D.5

Environmental Protection Officer:
Firefighter Training Facility Construction,
Operation, and Maintenance Costs

Question	Minimum	Maximum	Mean	Stnd Dev
Construction cost of present trng facility	$5K	$1.5M	$174K	$290K
Cost to build a new live-fire trng facility	$30K	$2.5M	$724K	$811K
Annual operating & maintenance expenses	$0.2K	$500K	$50K	

Table D.6

Bioenvironmental Engineer:
Regulatory Awareness & Activities

Question	YES	NO	DIDN'T KNOW
Does the SIP address live-fire training	18/63 28.6%	10/63 15.9%	35/63 55.6%
Is your base in an EPA Non-Attainment Area	13/60 21.7%	31/60 51.7%	16/60 26.7%
Is AFR 92-1 used to accept waste fuel for FD trng	17/33 51.5%	1/33 3.0%	15/33 45.4%
Does your office review fuel test results	5/33 15.2%	28/33 84.8%	
Has PRAgncy made inquiries about training fires	15/59 25.4%	44/59 74.6%	

Table D.7

Bioenvironmental Engineer: Air Emissions Inventories

Question	YES	NO	DIDN'T KNOW
AEI presented to base Envr Prot Committee	33/56 58.9%	13/56 23.2%	10/56 17.8%
AEI provided to PRAgncy	24/56 42.8%	20/56 35.7%	12/56 21.4%
AEI sent to or reviewed by MAJCOM	37/55 67.3%	10/55 18.2%	8/55 14.5%
Estimate of trng fire emissions in AEI	48/59 81.4%	11/59 18.6%	

Parameter	Minimum	Maximum	Mean	Stnd Dev
Number of training fires per year	4	120	27.0	27.5
Gallons of JP-4 burned per fire	50	1000	390.4	249.8
Estimated trng fire emissions By BEE, T/yr	2	1424.7	83.2	129.3

Table D.8

Fire Department: Training Effectiveness and Policy

Question	YES	NO	DIDN'T KNOW
Is there local envr/trng policy or procedures	26/51 51.0%	16/51 31.4%	9/51 17.6%
Has your MAJCOM issued environmental guidance	13/52 25.0%	27/52 51.9%	12/52 23.1%
Have you been trained at smoke abated facility	11/52 21.2%	39/52 75.0%	2/52 3.8%
Was smoke abated fire training acceptable	5/11 45.4%	4/11 36.4%	2/11 18.2%

Table D.9

Significance of Air Emissions From Practice Fires

Professional Group	Ratio & Percent That Believed Air Emissions Were Significant	
Envir Protection Off	18/47	38.3%
Bioenvironmental Eng	17/43	39.5%
Fire Department	15/24	62.5%
Total	50/114	43.8%

Table D.10

Fire Training Facility Groundwater Contamination Potential

Professional Group	Ratio & Percent That Believed There Was Groundwater Contamination Potential	
Envir Protection Off	30/55	54.5%
Bioenvironmental Eng	19/34	55.9%
Fire Department	13/34	38.2%
Total	62/123	50.4%

Table D.11

Air Quality vs Groundwater Contamination Potentials

Professional Group	Ratio & Percent That Believed Groundwater Contamination More Significant Than Air	
Envir Protection Off	35/64	54.7%
Bioenvironmental Eng	34/56	60.7%
Fire Department	12/42	28.6%
Total	81/162	50.0%

Table D.12

Reduce Air Emissions From All Firefighter Training Facilities

Statement: The USAF should take possitive steps to reduce air emissions from all firefighter training facilities.

Division	Distribution of Opinions, Count/Percent: Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	6 8.8%	28 41.2%	16 23.5%	14 20.6%	4 5.9%	68	4	3.26	1.07
BEE	1 1.8%	28 49.1%	15 26.3%	12 21.1%	1 1.8%	57	4	3.28	0.88
FD	8 15.4%	20 38.5%	10 19.2%	12 23.1%	2 3.8%	52	4	3.38	1.12
Mockup Category									
Cat A	11 11.7%	36 38.3%	21 22.3%	23 24.5%	3 3.2%	94	4	3.31	1.07
Cat B	4 6.8%	25 42.4%	14 23.7%	13 22.0%	3 5.1%	59	4	3.24	1.04
Cat C	0 0.0%	15 62.5%	6 25.0%	2 8.3%	1 4.2%	24	4	3.46	0.83
Geographic Region									
I-IV	7 13.5%	25 48.1%	9 17.3%	9 17.3%	2 3.8%	52	4	3.50	1.06
V-VII	3 5.0%	25 41.7%	15 25.0%	14 23.3%	3 5.0%	60	4	3.18	1.02
VIII-X	5 7.7%	26 40.0%	17 26.2%	15 23.1%	2 3.1%	65	4	3.26	1.00
All Bases	8.5%	42.9%	23.2%	21.5%	4.0%	177	4	3.31	1.03

Table D.13

Environmental or Public Relations Problem

Statement: The "environmental problem" associated with firefighter training facilities is one of public relations rather than emission of hazardous levels of air pollutants.

Division	Distribution of Opinions, Count/Percent: Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	2 2.9%	23 33.8%	14 20.6%	21 30.9%	8 11.8%	68	4	2.85	1.11
BEE	3 5.2%	14 24.1%	18 31.0%	21 36.2%	2 3.4%	58	2	2.81	0.98
FD	3 5.8%	13 25.0%	7 13.5%	26 50.0%	3 5.8%	52	2	2.75	1.08
Mockup Category									
Cat A	4 4.2%	27 28.7%	24 25.5%	32 34.0%	7 7.4%	94	2	2.88	1.05
Cat B	4 6.7%	16 26.7%	11 18.3%	25 41.7%	4 6.7%	60	2	2.85	1.10
Cat C	0 0.0%	7 29.2%	4 16.7%	11 45.8%	2 8.3%	24	2	2.67	1.00
Geographic Region									
I-IV	3 5.7%	13 24.5%	11 20.8%	23 43.4%	3 5.7%	53	2	2.81	1.06
V-VII	2 3.3%	19 31.7%	15 25.0%	19 31.7%	5 8.3%	60	2/4	2.90	1.05
VIII-X	3 4.6%	18 27.7%	13 20.0%	26 40.0%	5 7.7%	65	2	2.82	1.07
All Bases	4.5%	28.1%	21.9%	38.2%	7.3%	178	2	2.84	1.06

Table D.14

BEE/EPO Had Observed Training Fire

Respondent Group	Yes	No
Environmental Protection Officers	30/68 44.1%	38/68 55.9%
Bioenvironmental Engineers	15/60 25.0%	45/60 75.0%

Table D.15

Only Training Fires Without Smoke Abatement Are Effective

Statement: Only fires without air pollution controls can be used to adequately train fire-fighters.

Division	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	10 14.7%	15 22.1%	20 29.4%	20 29.4%	3 4.4%	68	2/3	3.13	1.13
BEE	3 5.5%	11 20.0%	18 32.7%	19 34.5%	4 7.3%	55	2	2.82	1.02
FD	7 14.0%	5 10.0%	5 10.0%	24 48.0%	9 18.0%	50	2	2.52	1.30
Mockup Category									
Cat A	10 11.0%	18 19.8%	27 29.7%	29 31.9%	7 7.7%	91	2	2.95	1.13
Cat B	8 13.8%	9 15.5%	11 19.0%	23 39.6%	7 12.1%	58	2	2.79	1.25
Cat C	2 8.3%	4 16.7%	5 20.8%	11 45.8%	2 8.3%	24	2	2.71	1.12
Geographic Region									
I-IV	5 9.8%	11 21.6%	16 31.4%	17 33.3%	2 3.9%	51	2	3.00	1.06
V-VII	8 13.6%	10 16.9%	17 28.8%	17 28.8%	7 11.9%	59	2/3	2.92	1.22
VIII-X	7 11.1%	10 15.9%	10 15.9%	29 46.0%	7 11.1%	63	2	2.70	1.20
All Bases	11.6%	17.9%	24.9%	36.4%	9.2%	173	2	2.86	1.17

Table D.16

Smoke Is Most Important Training Characteristic

Statement: Dense black smoke is the single most important characteristic of a training fire.

Division	Distribution of Opinions, Count/Percent: Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	7 10.3%	9 13.2%	14 20.6%	28 41.2%	10 14.7%	68	2	2.63	1.20
BEE	3 5.3%	17 29.8%	9 15.8%	20 35.1%	8 14.0%	57	2	2.77	1.18
FD	3 5.8%	3 5.8%	5 9.6%	29 55.8%	12 23.1%	52	2	2.15	1.04
Mockup Category									
Cat A	8 8.5%	10 10.6%	13 13.8%	45 47.9%	18 19.1%	94	2	2.41	1.17
Cat B	4 6.8%	13 22.0%	13 22.0%	20 33.9%	9 15.2%	59	2	2.71	1.18
Cat C	1 4.2%	6 25.0%	2 8.3%	12 50.0%	3 12.5%	24	2	2.58	1.14
Geographic Region									
I-IV	6 11.5%	6 11.5%	8 15.4%	26 50.0%	6 11.5%	52	2	2.62	1.19
V-VII	4 6.7%	12 20.0%	9 15.0%	21 35.0%	14 23.3%	60	2	2.52	1.24
VIII-X	3 4.6%	11 16.9%	11 16.9%	30 46.2%	10 15.4%	65	2	2.49	1.09
All Bases	7.3%	16.4%	15.8%	43.5%	16.9%	177	2	2.54	1.17

Table D.17

Performance In Real Fire Will Not Suffer

Statement: Performance in real aircraft crash fires will not suffer because of training at smoke abated firefighter training facilities.

Division	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	5 7.5%	18 26.9%	13 19.4%	24 35.8%	7 10.4%	67	2	2.85	1.16
BEE	4 7.0%	14 24.6%	19 33.3%	18 31.6%	2 3.5%	57	3	3.00	1.00
FD	4 7.8%	18 35.5%	10 19.6%	14 27.5%	5 9.8%	51	4	3.04	1.17
Mockup Category									
Cat A	7 7.5%	32 34.4%	21 22.6%	25 26.9%	8 8.6%	93	4	3.05	1.13
Cat B	5 8.6%	11 19.0%	14 24.1%	22 37.9%	6 10.3%	58	2	2.78	1.14
Cat C	1 4.2%	7 29.2%	7 29.2%	9 37.5%	0 0.0%	24	2	3.00	0.93
Geographic Region									
I-IV	2 3.8%	20 38.5%	6 11.5%	19 36.5%	5 9.6%	52	4	2.90	1.14
V-VII	2 3.3%	15 25.0%	17 28.3%	18 30.0%	8 13.3%	60	2	2.75	1.08
VIII-X	9 14.3%	15 23.8%	19 30.2%	19 30.2%	1 1.6%	63	2/3	3.19	1.08
All Bases	7.4%	28.6%	24.0%	32.0%	8.0%	175	2	2.95	1.11

Table D.18

Build New Smoke Abated Facility

Statement: Build new smoke abated firefighter training facility.

Division	Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	6 9.0%	15 22.4%	14 20.9%	21 31.3%	11 16.4%	67	2	2.76	1.23
BEE	4 7.1%	16 28.6%	10 17.9%	13 23.2%	13 23.2%	56	4	2.73	1.30
FD	10 19.2%	15 28.8%	10 19.2%	6 11.5%	11 21.2%	52	4	3.13	1.43
Mockup Category									
Cat A	11 11.8%	24 25.8%	21 22.6%	19 20.4%	18 19.4%	93	4	2.90	1.31
Cat B	7 11.9%	12 20.3%	10 16.9%	18 30.5%	12 20.3%	59	2	2.73	1.32
Cat C	2 8.7%	10 43.5%	3 13.0%	3 13.0%	5 21.7%	23	2	3.04	1.36
Geographic Region									
I-IV	6 11.3%	17 32.1%	10 18.9%	9 17.0%	11 20.8%	53	4	2.96	1.34
V-VII	6 10.2%	8 13.6%	15 25.4%	14 23.7%	16 27.1%	59	1	2.56	1.30
VIII-X	8 12.7%	21 33.3%	9 14.3%	17 27.0%	8 12.7%	63	4	3.06	1.28
All Bases	11.4%	26.3%	19.4%	22.9%	20.0%	175	4	2.86	1.32

Table D.19

Add Smoke Abatement to Existing Facility

Statement: Add air pollution controls to existing firefighter training facility.

Division	Distribution of Opinions, Count/Percent: Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	1 1.5%	10 15.2%	16 24.2%	26 39.4%	13 19.7%	66	2	2.39	1.02
BEE	1 1.8%	13 23.2%	13 23.2%	12 21.4%	17 30.4%	56	1	2.45	1.20
FD	6 11.5%	16 30.8%	7 13.5%	9 17.3%	14 26.9%	52	4	2.83	1.42
Mockup Category									
Cat A	4 4.3%	21 22.8%	19 20.6%	26 28.3%	22 23.9%	92	2	2.55	1.21
Cat B	3 5.1%	11 18.6%	10 16.9%	18 30.5%	17 28.8%	59	2	2.41	1.23
Cat C	1 4.3%	7 30.4%	7 30.4%	3 13.0%	5 21.7%	23	3/4	2.83	1.23
Geographic Region									
I-IV	3 5.7%	16 30.2%	10 18.9%	15 28.3%	9 17.0%	53	4	2.79	1.21
V-VII	3 5.1%	9 15.2%	16 27.1%	16 27.1%	15 25.4%	59	2/3	2.47	1.18
VIII-X	2 3.2%	14 22.6%	10 16.1%	16 25.8%	20 32.2%	62	1	2.39	1.25
All Bases	4.6%	22.4%	20.7%	27.0%	25.3%	174	2	2.54	1.22

Table D.20

Decrease Quantity of Fuel Burned

Statement: Decrease quantity of fuel burned.

Division	Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	5 7.4%	24 35.3%	21 30.9%	13 19.1%	5 7.4%	68	4	3.16	1.06
BEE	8 14.5%	17 30.9%	17 30.9%	12 21.8%	1 1.8%	55	3/4	3.35	1.04
FD	2 3.8%	2 3.8%	5 9.6%	20 38.5%	23 44.2%	52	1	1.85	1.02
Mockup Category									
Cat A	8 8.6%	24 25.8%	22 23.6%	26 28.0%	13 14.0%	93	2	2.87	1.20
Cat B	5 8.3%	11 18.3%	16 26.7%	18 30.0%	10 16.7%	60	2	2.72	1.19
Cat C	2 9.1%	8 36.4%	5 22.7%	1 4.5%	6 27.3%	22	4	2.95	1.40
Geographic Region									
I-IV	6 11.3%	13 24.5%	10 18.9%	11 20.8%	13 24.5%	53	1/4	2.77	1.37
V-VII	4 6.9%	17 29.3%	17 29.3%	15 25.9%	5 8.6%	58	3/4	3.00	1.09
VIII-X	5 7.8%	13 20.3%	16 25.0%	19 29.7%	11 17.2%	64	2	2.72	1.20
All Bases	0.6%	24.6%	24.6%	25.1%	16.6%	175	2	2.83	1.22

Table D.21

Decrease Number of Training Fires

Statement: Decrease number of training fires.

Division	Distribution of Opinions, Count/Percent: Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	2 2.9%	13 19.1%	18 26.5%	26 38.2%	9 13.2%	68	2	2.60	1.04
BEE	6 10.9%	13 23.6%	17 30.9%	16 29.1%	3 5.5%	55	3	3.05	1.10
FD	2 3.8%	3 5.8%	1 1.9%	14 26.9%	32 61.5%	52	1	1.63	1.05
Mockup Category									
Cat A	4 4.2%	15 16.0%	20 21.3%	34 36.2%	21 22.3%	94	2	2.44	1.13
Cat B	5 8.5%	7 11.9%	11 18.6%	18 30.5%	18 30.5%	59	1/2	2.37	1.27
Cat C	1 4.5%	7 31.8%	5 22.7%	4 18.2%	5 22.7%	22	4	2.77	2.27
Geographic Region									
I-IV	0 0.0%	10 18.9%	9 17.0%	16 30.2%	18 34.0%	53	1	2.21	1.12
V-VII	4 6.9%	8 13.8%	14 24.1%	20 34.5%	12 20.7%	58	2	2.52	1.17
VIII-X	6 9.4%	11 17.2%	13 20.3%	20 31.2%	14 21.9%	64	2	2.61	1.27
All Bases	5.7%	16.6%	20.6%	32.0%	25.1%	175	2	2.46	1.20

Table D.22

Replace Live-Fire Training With Simulators

Statement: Develop training simulators to replace live-fire burn pits.

Division	Distribution of Opinions, Count/Percent					Sample Size	Central Tendency		Stnd Dev
	Practical 5	4	Neutral 3	2	Impractical 1		Mode	Mean	
Professional Group									
EPO	3 4.4%	11 16.2%	19 27.9%	21 30.9%	14 20.6%	68	2	2.53	1.13
BEE	1 1.8%	11 19.3%	20 35.1%	17 29.8%	8 14.0%	57	3	2.65	1.01
FD	3 5.8%	3 5.8%	8 15.4%	11 21.2%	27 51.9%	52	1	1.92	1.20
Mockup Category									
Cat A	3 3.2%	10 10.8%	27 29.0%	27 29.0%	26 28.0%	93	2/3	2.32	1.10
Cat B	2 3.3%	10 16.7%	13 21.7%	17 28.3%	18 30.0%	60	1	2.35	1.18
Cat C	2 8.3%	5 20.8%	7 29.2%	5 20.8%	5 20.8%	24	3	2.75	1.26
Geographic Region									
I-IV	5 9.4%	8 15.1%	16 30.2%	16 30.2%	8 15.1%	53	2/3	2.74	1.18
V-VII	0 0.0%	9 15.2%	12 20.3%	16 27.1%	22 37.2%	59	1	2.14	1.09
VIII-X	2 3.1%	8 12.3%	19 29.2%	17 26.2%	19 29.2%	65	1/3	2.34	1.12
All Bases	4.0%	14.1%	26.6%	27.7%	27.7%	177	1/2	2.39	1.15

Table D.23

Relocate Facility

Statement: Relocate firefighter training facility in a remote area of the base.

Division	Distribution of Opinions, Count/Percent: Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	13 19.1%	10 14.7%	16 23.5%	12 17.6%	17 25.0%	68	1	2.85	1.45
BEE	6 10.7%	8 14.3%	19 33.9%	12 21.4%	11 19.6%	56	3	2.75	1.24
FD	12 23.1%	6 11.5%	11 21.2%	7 13.5%	16 30.8%	52	1	2.83	1.56
Mockup Category									
Cat A	15 16.1%	13 14.0%	24 25.8%	16 17.2%	25 26.9%	93	1	2.75	1.41
Cat B	10 16.7%	8 13.3%	14 23.3%	15 25.0%	13 21.7%	60	2	2.78	1.38
Cat C	6 26.1%	3 13.0%	8 34.8%	0 0.0%	6 26.1%	23	3	3.13	1.52
Geographic Region									
I-IV	10 18.8%	9 17.0%	14 26.4%	6 11.3%	14 26.4%	53	1/3	2.91	1.46
V-VII	8 13.6%	7 11.8%	13 22.0%	13 22.0%	18 30.5%	59	1	2.56	1.39
VIII-X	13 20.3%	8 12.5%	19 29.6%	12 18.8%	12 18.8%	64	3	2.97	1.38
All Bases	17.6%	13.6%	26.1%	17.6%	25.0%	176	3	2.81	1.41

Table D.24

Send Firefighters to Regional Training Centers.

Statement: Send firefighters TDY to regional training center.

Division	Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	9 13.2%	9 13.2%	11 16.2%	19 27.9%	20 29.4%	68	1	2.53	1.39
BEE	11 19.0%	14 24.1%	12 20.7%	11 19.0%	10 17.2%	58	4	3.09	1.38
FD	3 5.8%	6 11.5%	3 5.8%	10 19.2%	30 57.7%	52	1	1.88	1.28
Mockup Category									
Cat A	13 13.8%	18 19.1%	12 12.8%	24 25.5%	27 28.7%	94	1	2.64	1.43
Cat B	5 8.3%	7 11.7%	10 16.7%	14 23.3%	24 40.0%	60	1	2.25	1.32
Cat C	5 20.8%	4 16.7%	4 16.7%	2 8.3%	9 37.5%	24	1	2.75	1.62
Geographic Region									
I-IV	9 17.0%	9 17.0%	11 20.8%	6 11.3%	18 34.0%	53	1	2.72	1.51
V-VII	9 15.0%	9 15.0%	11 18.3%	12 20.0%	19 31.6%	60	1	2.62	1.45
VIII-X	5 7.6%	11 16.9%	4 6.2%	22 33.8%	23 35.4%	65	1	2.28	1.32
All Bases	12.9%	16.3%	14.6%	22.5%	33.7%	178	1	2.52	1.43

Table D.25

Become A Regional Training Center.

Statment: Having your base serve as a regional training center.

Division	Practical 5	4	Neutral 3	2	Impractical 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	6 8.8%	9 13.2%	23 33.8%	14 20.6%	16 23.5%	68	3	2.63	1.23
BEE	3 5.3%	9 15.8%	19 33.3%	12 21.1%	14 24.6%	57	3	2.56	1.18
FD	6 11.5%	4 7.7%	8 15.4%	11 21.2%	23 44.2%	52	1	2.21	1.39
Mockup Category									
Cat A	10 10.8%	16 17.2%	19 20.4%	21 22.6%	27 29.0%	93	1	2.58	1.35
Cat B	2 3.3%	5 8.3%	23 38.3%	12 20.0%	18 30.0%	60	3	2.35	1.10
Cat C	3 12.5%	1 4.2%	8 33.3%	4 16.7%	8 33.3%	24	1/3	2.46	1.35
Geographic Region									
I-IV	5 9.4%	6 11.3%	18 34.0%	10 18.8%	14 26.4%	53	3	2.58	1.26
V-VII	7 11.8%	5 8.4%	17 28.8%	13 22.0%	17 28.8%	59	1/3	2.53	1.32
VIII-X	3 4.6%	11 16.9%	15 23.1%	14 21.5%	22 33.8%	65	1	2.37	1.24
All Bases	8.5%	12.4%	28.2%	20.9%	29.9%	177	1	2.49	1.27

Table D.26

Stop Live-Fire Training AF-Wide

Statement: Stop live-fire training AF-wide.

Division	Distribution of Opinions, Count/Percent					Sample Size	Central Tendency		Stnd Dev
	Practical 5	4	Neutral 3	2	Impractical 1		Mode	Mean	
Professional Group									
EPO	1 1.5%	0 0.0%	2 2.9%	14 20.6%	51 75.0%	68	1	1.32	0.68
BEE	0 0.0%	1 1.7%	7 12.1%	15 25.9%	35 60.3%	58	1	1.55	0.78
FD	1 1.9%	1 1.9%	1 1.9%	3 5.8%	46 88.5%	52	1	1.23	0.76
Mockup Category									
Cat A	1 1.1%	1 1.1%	2 2.1%	17 18.1%	73 77.6%	94	1	1.30	0.67
Cat B	1 1.7%	0 0.0%	4 6.7%	11 18.3%	44 73.3%	60	1	1.38	0.76
Cat C	0 0.0%	1 4.2%	4 16.7%	4 16.7%	15 62.5%	24	1	1.63	0.92
Geographic Region									
I-IV	1 1.8%	1 1.8%	2 3.8%	11 20.8%	38 71.6%	53	1	1.42	0.82
V-VII	0 0.0%	1 1.6%	3 5.0%	12 20.0%	44 73.3%	60	1	1.35	0.66
VIII-X	1 1.5%	0 0.0%	5 7.6%	9 13.8%	50 76.9%	65	1	1.35	0.76
All Bases	1.1%	1.1%	5.6%	18.0%	74.2%	178	1	1.37	0.74

Table D.27

Use Meteorological Burn/No-Burn Criteria

Statement: Adopt meteorological go/no-go criteria to insure optimum dispersion conditions during training fires.

Division	Distribution of Opinions, Count/Percent					Sample Size	Central Tendency		Stnd Dev
	Practical 5	4	Neutral 3	2	Impractical 1		Mode	Mean	
Professional Group									
EPO	29 42.6%	21 30.9%	12 17.6%	3 4.4%	3 4.4%	68	5	4.03	1.09
BEE	23 40.4%	26 45.6%	6 10.5%	1 1.8%	1 1.8%	57	4	4.21	0.84
FD	17 32.7%	18 34.6%	13 25.0%	1 1.9%	3 5.8%	52	4	3.87	1.09
Mockup Category									
Cat A	38 40.4%	33 35.1%	20 21.3%	2 2.1%	1 1.1%	94	5	4.12	0.89
Cat B	21 35.0%	25 41.7%	7 11.7%	2 3.3%	5 8.3%	60	4	3.92	1.17
Cat C	10 43.5%	7 30.4%	4 17.4%	1 4.3%	1 4.3%	23	5	4.04	1.11
Geographic Region									
I-IV	22 41.5%	19 35.8%	10 18.8%	1 1.8%	1 1.8%	53	5	4.13	0.92
V-VII	18 30.5%	21 35.6%	17 28.8%	2 3.4%	1 1.6%	59	4	3.90	0.94
VIII-X	29 44.6%	25 38.5%	4 6.2%	2 3.1%	5 7.7%	65	5	4.09	1.16
All Bases	39.0%	36.7%	17.5%	2.8%	4.0%	177	5	4.04	1.02

Table D.28

Current Regulations Are Effective

Statement: Current regulations are effectively limiting firefighter training facility air emissions.

Division	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency Mode	Central Tendency Mean	Stnd Dev
Professional Group									
EPO	1 1.5%	12 17.6%	29 42.6%	23 33.8%	3 4.4%	68	3	2.78	0.84
BEE	0 0.0%	4 7.4%	21 38.9%	28 51.9%	1 1.9%	54	2	2.52	0.67
FD	2 3.8%	14 26.9%	14 26.9%	17 32.7%	5 9.6%	52	2	2.83	1.06
Mockup Category									
Cat A	0 0.0%	11 12.0%	39 42.4%	37 40.2%	5 5.4%	92	3	2.61	0.77
Cat B	3 5.2%	13 22.4%	18 31.0%	20 34.5%	4 6.9%	58	2	2.84	1.02
Cat C	0 0.0%	6 25.0%	7 29.2%	11 45.8%	0 0.0%	24	2	2.79	0.83
Geographic Region									
I-IV	1 1.9%	12 23.1%	15 28.8%	21 40.4%	3 5.8%	52	2	2.75	0.95
V-VII	2 3.4%	9 15.5%	25 43.1%	19 32.8%	3 5.2%	58	3	2.79	0.89
VIII-X	0 0.0%	9 14.1%	24 37.5%	28 43.8%	3 4.7%	64	2	2.61	0.79
All Bases	1.7%	17.2%	36.8%	39.1%	5.2%	174	2	2.71	0.87

Table D.29

Emissions Could Be Reduced Through Effective Management

Statement: Firefighter training facility air emissions could be reduced by effective air quality management in lieu of installation of costly air pollution controls.

Division	Distribution of Opinions, Count/Percent					Sample Size	Central Tendency		Stnd Dev
	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1		Mode	Mean	
Professional Group									
EPO	3 4.4%	31 45.6%	21 30.9%	12 17.6%	1 1.5%	68	4	3.34	0.87
BEE	1 1.8%	24 42.9%	24 42.9%	6 10.7%	1 1.8%	56	3/4	3.32	0.77
FD	5 9.6%	13 25.0%	18 34.6%	15 28.8%	1 1.9%	52	3	3.12	1.00
Mockup Category									
Cat A	4 4.3%	34 36.6%	31 33.3%	22 23.6%	2 2.2%	93	4	3.17	0.92
Cat B	5 8.5%	20 33.9%	24 40.7%	9 15.3%	1 1.7%	59	3	3.32	0.90
Cat C	0 0.0%	14 58.3%	8 33.3%	2 8.3%	0 0.0%	24	4	3.50	0.66
Geographic Region									
I-IV	1 1.9%	22 42.3%	19 36.5%	9 17.3%	1 1.9%	52	4	3.25	0.84
V-VII	4 6.8%	25 42.4%	20 33.9%	9 15.2%	1 1.7%	59	4	3.37	0.89
VIII-X	4 6.2%	21 32.3%	24 36.9%	15 23.1%	1 1.5%	65	3	3.18	0.92
All Bases	5.1%	38.6%	35.8%	18.8%	1.7%	176	4	3.27	0.88

Table D.30

Need More Standardization & Better Regulation

Statement: Firefighter training facility operation and use should be more standardized and better regulated AF-wide.

Division	Distribution of Opinions, Count/Percent: Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1	Sample Size	Central Tendency: Mode	Mean	Stnd Dev
Professional Group									
EPO	22 32.4%	24 35.3%	13 19.1%	6 8.8%	3 4.4%	68	4	3.82	1.12
BEE	14 24.1%	30 51.7%	11 19.0%	3 5.2%	0 0.0%	58	4	3.95	0.80
FD	14 26.9%	27 51.9%	7 13.5%	4 7.7%	0 0.0%	52	4	3.98	0.85
Mockup Category									
Cat A	30 31.9%	42 44.7%	12 12.8%	9 9.6%	1 1.1%	94	4	3.97	0.97
Cat B	16 26.7%	26 43.3%	15 25.0%	2 3.3%	1 1.7%	60	4	3.90	0.90
Cat C	4 16.7%	13 54.2%	4 16.7%	2 8.3%	1 4.2%	24	4	3.71	1.00
Geographic Region									
I-IV	15 28.3%	27 50.9%	7 13.2%	4 7.5%	0 0.0%	53	4	4.00	0.85
V-VII	14 23.3%	28 46.7%	12 20.0%	4 6.7%	2 3.3%	60	4	3.80	0.99
VIII-X	21 32.3%	26 40.0%	12 18.5%	5 7.7%	1 1.5%	65	4	3.94	0.98
All Bases	28.1%	45.5%	17.4%	7.3%	1.7%	178	4	3.91	0.95

Table D.31

Need More Management Attention

Statement: More management attention to use/operation of firefighter training facilities is needed.

Division	Distribution of Opinions, Count/Percent					Sample Size	Central Tendency		Stnd Dev
	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1		Mode	Mean	
Professional Group									
EPO	8 11.9%	34 50.7%	16 23.9%	8 11.9%	1 1.5%	67	4	3.60	0.91
BEE	4 7.0%	34 59.6%	17 29.8%	2 3.5%	0 0.0%	57	4	3.70	0.65
FD	8 15.4%	22 42.3%	12 23.1%	9 17.3%	1 1.9%	52	4	3.52	1.02
Mockup Category									
Cat A	8 8.7%	53 57.6%	23 25.0%	6 7.6%	1 1.1%	92	4	3.65	0.79
Cat B	11 18.3%	22 36.7%	16 28.3%	9 15.0%	1 1.7%	60	4	3.55	1.02
Cat C	1 4.2%	15 62.5%	5 20.8%	3 12.5%	0 0.0%	24	4	3.58	0.78
Geographic Region									
I-IV	5 9.6%	33 63.5%	9 17.3%	5 9.6&	0 0.0%	52	4	3.73	0.77
V-VII	7 11.9%	26 44.1%	14 23.7%	10 16.9%	2 3.4%	59	4	3.44	1.02
VIII-X	8 12.3%	31 47.7%	22 33.8%	4 6.2%	0 0.0%	65	4	3.66	0.78
All Bases	11.4%	51.1%	25.6%	10.8%	1.1%	176	4	3.61	0.87

Table D.32

Burn Waste Fuel For Firefighter Training

Respondent	Yes	No	Didn't Know
Bioenvironmental Eng	33/60 55.0%	20/60 33.3%	7/60 11.7%
Envir Protection Off	44/68 64.7%	22/68 32.4%	2/68 2.9%
Fire Department	40/74 54.0%	34/74 45.9%	

Table D.33

Are Fuel Prohibitions Observed

Respondent	Yes	No	Didn't Know
Bioenvironmental Eng	17/33 51.5%	1/33 3.0%	15/33 45.4%
Envir Protection Off	41/46 89.1%	1/46 2.2%	4/46 8.7%

Table D.34

Included In Coordination

Respondent	Yes	Never
Bioenvironmental Eng	13/57 22.8%	44/57 77.2%
Envir Protection Off	22/66 33.3%	44/66 66.7%
Fire Department	52/52 100%	0/52 0.0%

Table D.35

Coordinate With Local Pollution Regulatory Agency

Respondent	Yes	Never	Didn't Know
Fire Department	33/52 63.5%	15/52 28.8%	4/52 7.7%
Envir Protection Off	32/64 50.0%	21/64 32.8%	11/64 17.2%

Table D.36

Received Complaints About Practice Fires

Respondent	Yes	No
Bioenvironmental Eng	3/57 5.3%	54/57 94.7%
Envir Protection Off	9/68 13.2%	59/68 86.8%
Fire Department	9/52 17.3%	43/52 82.7%
Total	21/177 11.9%	

Table D.37

Firefighter Training Parameters & Index - Geographic Region

Region	Parameter	Sample Size	Mean	Stnd Dev	Min	Max
All	# Mil FFs	73	42.8	13.1	6	86
	# Civ FFs	73	31.0	21.0	3	122
	# Trained	74	64.1	19.7	11	140
	X Trnd/yr	70	5.6	4.4	2	28
	FTI(1),FF/fire	61	17.8	18.0	2.9	116.0
	FTI(2),gal/FF	61	46.9	49.9	4.0	339.3
I-IV	# Mil FFs	23	41.3	12.4	6	59
	# Civ FFs	23	29.0	12.1	15	63
	# Trained	24	60.0	17.4	11	99
	X Trnd/yr	23	5.3	4.3	2	20
	FTI(1), FF/fire	20	17.0	15.0	3.6	61.3
	FTI(2), gal/FF	20	42.1	31.2	8.2	130.4
V-VII	# Mil FFs	26	39.6	10.0	17	56
	# Civ FFs	27	33.7	25.2	12	122
	# Trained	27	62.6	15.5	40	104
	X Trnd/yr	25	4.6	1.7	2	8
	FTI(1), FF/fire	21	18.4	24.2	3.8	116.0
	FTI(2), gal/FF	21	42.1	31.5	4.0	116.4
VIII-X	# Mil FFs	24	47.5	15.6	15	86
	# Civ FFs	23	29.8	23.1	3	87
	# Trained	23	70.2	25.0	39	140
	X Trnd/yr	22	7.0	6.3	2	28
	FTI(1), FF/fire	20	18.1	13.3	2.9	52.5
	FTI(2), gal/FF	20	56.6	75.6	5.7	339.3

Table D.38

Firefighter Training Parameters & Index - Study Category

Study Category	Parameter	Sample Size	Mean	Stnd Dev	Min	Max
All	# Mil FFs	73	42.8	13.1	6	86
	# Civ FFs	73	31.0	21.0	3	122
	# Trained	74	64.1	19.7	11	140
	X Trnd/yr	70	5.6	4.4	2	28
	FTI(1), FF/fire	61	17.8	18.0	2.9	116.0
	FTI(2), gal/FF	61	46.9	49.9	4.0	339.3
Cat A	# Mil FFs	42	43.6	15.0	6	86
	# Civ FFs	42	31.5	22.9	3	122
	# Trained	41	66.2	23.3	11	140
	X Trnd/yr	40	4.8	3.2	2	20
	FTI(1), FF/fire	37	17.0	19.7	2.9	116.0
	FTI(2), gal/FF	37	59.6	59.8	8.6	339.3
Cat B	# Mil FFs	27	41.5	10.5	17	60
	# Civ FFs	27	31.1	19.7	12	87
	# Trained	29	62.7	14.1	39	108
	X Trnd/yr	26	7.0	6.0	2	28
	FTI(1), FF/fire	21	19.8	16.2	4.6	61.3
	FTI(2), gal/FF	21	28.2	16.7	4.0	66.4
Cat C	# Mil FFs	4	42.0	4.2	37	47
	# Civ FFs	4	24.5	1.9	22	26
	# Trained	4	53.5	7.6	48	64
	X Trnd/yr	4	4.2	1.3	3	6
	FTI(1),FF/fire	3	14.7	5.2	9.0	19.2
	FTI(2),gal/FF	3	20.7	8.3	11.1	26.0

Table D.39

Intra-Base Facility Use Index Comparison
Calculated from Different Data Sets

FD FUI, tons AP/yr	AEI FUI, tons AP/yr	% Difference from FD FUI	IRP FUI, tons AP/yr	% Difference from FD FUI	% Difference from BEE FUI
6.6	4.3	-35%	24.4	270%	467%
6.8	6.8	0%	6.8	0%	0%
6.8	43.8	544%	8.1	19%	-82%
8.1	2.0	-75%	5.4	-33%	170%
13.5	30.3	124%	61.0	352%	101%
16.3	72.3	343%	81.3	399%	12%
16.3	73.1	348%	93.2	472%	27%
20.3	7.1	-65%	26.4	30%	272%
20.3	9.5	-53%	9.5	-53%	0%
28.5	28.5	0%	24.4	-14%	-14%
28.5	32.0	12%	36.6	28%	14%
30.5	4.0	-87%	4.1	-86%	2%
30.5	23.7	-22%	8.1	-73%	-66%
30.8	23.6	-23%	16.3	-47%	-31%
32.5	8.9	-73%	10.2	-69%	15%
34.6	67.9	96%	19.0	-45%	-72%
40.6	32.5	-20%	121.9	200%	275%
42.0	19.3	-54%	24.2	-42%	26%
42.7	40.7	-5%	30.5	-28%	-25%
45.4	19.8	-56%	7.6	-83%	-62%
47.4	42.3	-11%	101.6	114%	140%
48.8	43.7	-10%	4.1	-92%	-91%
50.8	183.0	260%	48.8	-4%	-73%
57.6	7.6	-87%	12.2	-79%	60%
62.8	36.6	-42%	36.6	-42%	0%
Avg 30.8	34.5		32.9		

Table D.40

Facility Construction Date
(Presented by Mockup Category and Geographic Regions)

CNSTDT = date training area was first put into use, year

Study Division	Study Variable	Sample Size	Min	Max	Arith-metic Mean	Stnd Devi-ation
All Bases	CNSTDT, year	67	1940	1987	1973	11.6
Cat A	CNSTDT, year	37	1950	1987	1975	9.6
Cat B	CNSTDT, year	27	1940	1986	1971	14.1
Cat C	CNSTDT, year	3	1963	1982	1974	9.8
I-IV	CNSTDT, year	22	1942	1986	1973	12.2
V-VII	CNSTDT, year	24	1940	1987	1974	11.6
VIII-X	CNSTDT, year	21	1950	1986	1972	11.5

Table D.41

Burn Surface Diameter
(Presented by Mockup Category and Geographic Regions)

PITDIA = diameter of fuel pool or burn surface, ft

Division	Study Variable	Sample Size	Min	Max	Arith-metic Mean	Stnd Devi-ation
All Bases	PITDIA, ft	70	20	600	100.6	79.4
Category						
A	PITDIA, ft	37	38	300	107.8	57.0
B	PITDIA, ft	29	30	600	91.7	103.0
C	PITDIA, ft	4	20	200	98.8	75.3
Regions						
I-IV	PITDIA, ft	22	50	600	112.2	117.7
V-VII	PITDIA, ft	26	20	200	79.2	40.0
VIII-X	PITDIA, ft	22	50	300	114.2	64.0

Table D.42

Distances From Training Area to Property Line and Facilities

BNDRY = distance to installation boundary, mi
ONBFAC = distance to nearest on-base facility, mi
OFBFAC = distance to nearest off-base facility, mi

Mockup Category	Study Variable	Sample Size	Min	Max	Arith-metic Mean	Stnd Devi-ation
All Bases	BNDRY, mi	66	0.04	8.0	0.72	1.13
Category						
A	BNDRY, mi	36	0.04	8.0	0.84	1.45
B	BNDRY, mi	26	0.06	1.0	0.47	0.30
C	BNDRY, mi	4	0.40	3.0	1.23	1.21
Regions						
I-IV	BNDRY, mi	21	0.10	3.0	0.72	0.70
V-VII	BNDRY, mi	24	0.04	3.0	0.48	0.61
VIII-X	BNDRY, mi	21	0.06	8.0	0.98	1.76
All Bases	ONBFAC, mi	65	0.04	2.0	0.56	0.47
Category						
A	ONBFAC, mi	38	0.04	2.0	0.52	0.46
B	ONBFAC, mi	23	0.10	2.0	0.64	0.52
C	ONBFAC, mi	4	0.25	0.8	0.51	0.22
Regions						
I-IV	ONBFAC, mi	22	0.04	1.5	0.52	0.42
V-VII	ONBFAC, mi	24	0.07	2.0	0.62	0.57
VIII-X	ONBFAC, mi	19	0.06	1.5	0.54	0.39
All Bases	OFBFAC, mi	65	0.06	30.0	2.85	4.11
Category						
A	OFBFAC, mi	36	0.06	30.0	2.81	4.88
B	OFBFAC, mi	25	0.10	14.0	3.08	3.09
C	OFBFAC, mi	4	0.40	5.0	1.80	2.15
Regions						
I-IV	OFBFAC, mi	22	0.10	5.0	1.58	1.31
V-VII	OFBFAC, mi	24	0.10	7.0	2.39	1.93
VIII-X	OFBFAC, mi	19	0.06	30.0	4.91	6.82

Table D.43

Facilities Currently Shut Down
Presented by Mockup Category and Geogrphic Regions

Study Division	No. Facilities In Study Division	No. Facilities Known To Be Shut Down
No.of Bases	76	8
Mockup Category		
A	43	3
B	28	4
C	5	1
By Regions		
I-IV	25	2
V-VII	27	3
VIII-X	24	3

APPENDIX E

Appendix E

NORTH CAROLINA AIR QUALITY IMPLEMENTATION PLAN
(51.13).0520 CONTROL AND PROHIBITION OF OPEN BURNING - Statutory Authority G.S. 143-215.3(a)(1) 143-215.107(a)(5)
December 1, 1976

(a) Purpose. This Regulation is for the purpose of preventing, abating, and controlling air pollution resulting from air contaminants released in the open burning of refuse or other combustible materials.

(b) Scope. This Regulation shall apply to all operations involving open burning except those specifically exempted by Subdivision (d) of this Regulation.

(d) Permissible Open Burning. While recognizing that open burning contributes to air pollution, the commission is aware that certain types of open burning may reasonably be allowed in the public interest; therefore, the following types of open burning are permissible as specified if burning is not prohibited by ordinances and regulations of governmental entities having jurisdiction. The authority to conduct open burning under the provisions of this Regulation does not exempt or excuse any person from the consequences, damages or injuries which may result from such conduct, nor does it excuse or exempt any person from complying with all applicable laws, ordinances, regulations and orders of the governmental entities having jurisdiction even though the open burning is conducted in compliance with this Regulation. Permission granted under the authority of the commission under this Regulation shall be subject to continuing review and may be withdrawn at any time:

(2) fires purposely set for the instruction and training of fire-fighting personnel at permanent fire-fighting training facilities when conducted by a fire department, provided that such fires will not be permitted if the primary purpose in setting the fire is refuse disposal or recovery of salvageable materials. Factors which may be considered in determination of primary purpose include type, amount, and nature of combustible substances;

(3) fires purposely set for the instruction and training of industrial fire-fighting personnel in training programs which are repetitious and continuous in nature if a plan containing

program aspects related to possible air pollution including, but not limited to nature and location of the exercise, nature of materials to be burned, amount of each type of material to be burned; training objectives of the exercise, and, insofar as it is known, a schedule of dates and times of the exercises, has been submitted to and has been approved by the Director of the Division of Environmental Management, provided that such fires will not be permitted if the primary purpose in setting the fire is refuse disposal or recovery of salvageable materials; Factors which may be considered in determination of primary purpose include type, amount and nature of combustible substances. Any deviations from the dates and times of exercises, including additions, postponements, and deletions, submitted in the schedule in the approved plan will be communicated verbally to the appropriate departmental field office at least one hour before the change;

(4) fires purposely set for the instruction and training of public and industrial fire-fighting personnel not covered under Subdivisions (d)(1), (d)(2), or (d)(3) of this Regulation, if the training program aspects related to possible air pollution effects are approved in advance by the air quality section and provided these fire-fighting exercise conditions are met:

(A) The appropriate departmental field office must be initially notified verbally or in writing at least 48 hours in advance of any burning conducted in conjunction with a fire training exercise. If initial notice is given verbally, a written notification must also be submitted within 24 hours of the initial verbal notification. The notification, either written or verbal, must include nature and location of the exercise, date and time exercise is to be held, nature of materials to be burned amount of each type of material to be burned, and training objectives of the exercise;

(B) The burning of salvageable items, including but not limited to insulated wire and electric motors, will not be exempted as a fire-training exercise, except as provided in Subdivision (C)(iii) of this Paragraph;

(C) the air quality regional engineer for the appropriate departmental field office may withhold approval for burnings purposely set for fire-fighting exercises, other than those described in Subdivisions (d)(1), (d)(2), and (d)(3) of this Regulation, in the following cases:

(i) when the required notice has not been received 48 hours in advance of the proposed burning;

(ii) when the required notice does not include adequate details with respect to the nature and location of the exercise, date and time the exercise is to be held,

nature of objects or materials to be burned, amount of each type of material to be burned, and training objectives of the exercise;

(iii) when salvageable items are proposed to be burned in conjunction with the exercise, except that the regional engineer may allow an exercise involving the burning of a motor vehicle if the sole objective is instruction on the techniques of fighting such a fire; The number of motor vehicles burned over a period of time by any one training unit or by several related training units shall be considered in determining the objective of the exercises;